COLLECTION OF REPORTS ON VIBRATION SURVEYS

CONDUCTED BY

PUGET SOUND NAVAL SHIPYARD

During 1962

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BUSHIPS 9400-2

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dtd 4 October 1961

TABLE OF CONTENTS

(270/275)
LPH2/9080
T-23253

8 FEB 1962

From: Commander, Puget Sound Naval Shipyard
To: Chief, Bureau of Ships

Subj: USS IWO JIMA (LPH2); report of underway vibration trials

Ref: (a) BUSHIPS ltr LPH2 Ser 345-378 of 18 Dec 1961
(b) DTMB Report 1451 "Ship Vibration" Dec 1960

Encl: (1) USS IWO JIMA (LPH2) Notice 4730:03:lwg of 9 Jan 1962
(2) LPH2 Vibration Trial Data, Table I
(3) LPH2 Vibration Trial Data, Table II
(4) LPH2 Vibration Trial Data, Figures I through IV
(5) Trial Oscillograph Records (1) through (49) (Originals)
(6) LPH2 Vibration Trial Recording Instrument Calibration Curve
(7) LPH2 Ship's Force Observer Reports of Vibration
(8) LPH2 JOOD Trial Log of Ship Operating Conditions

1. Vibration trials were conducted on the USS IWO JIMA (LPH2) at sea near San Diego, California, on 10-11 January 1962, in response to and in general accordance with the request of reference (a). Displacement of the vessel at time of leaving port on 10 January 1962 was 15,900 tons. Corresponding drafts were 23'-3" fwd and 24'-6" aft. Designed full load displacement is 17,933 tons with a mean draft of 26'-1". Displacement upon return to port on 12 January 1962 was 15,300 tons corresponding to drafts of 22'-10" fwd and 24'-0" aft. Sea state and wind conditions were mild throughout the trials. The trials were coordinated by a representative from Puget Sound Naval Shipyard. The ship's force established favorable operating conditions and provided personnel to visually observe vibration conditions throughout the ship. Recording instruments and technical assistance were provided by personnel from Long Beach Naval Shipyard. Observers was present from Philadelphia Naval Shipyard. They provided assistance during the trials and offered helpful suggestions.

2. The trials were conducted in two phases. During the first phase, 10 January, ship speeds were increased from 30 propeller shaft RPM (SRPM) to 117 SRPM in increments of 10 SRPM. Transverse and vertical transducers were mounted on the stern chock, main deck, centerline. CEC Type 4-102A velocity meters were used in conjunction with a Brush dual channel oscillograph, MK II, as the basic recording system. Records from these transducers were obtained at each stabilized speed increment in free route ahead and then under conditions of 35° right and left rudder for a 360° turn in each direction. In addition, an observer checked main propulsion components with an Askania portable vibration recorder to determine if resonant conditions developed during any of these ship operations. During this phase, also, ship's force observers were instructed to record items and areas of maximum vibration throughout the ship. Enclosure (1) outlines the operations during this phase of the trials and summarizes instructions to

the ship's force observers. Additional instructions were given orally in conference, to ship department heads and their representatives.

3. During the second phase of the trials, 11 January, the ship was operated steadily at 117 SRPM, nominal. Turns were also made at this speed as requested by the trial coordinator. Within the time available measurements were obtained with the Brush recording system at selected positions on propulsion machinery components, on the main deck near amidships (over bulkhead at frame 63), at the bow check (01 level forward), at the base of the mast at 06 level, at selected positions in the medical spaces, and on the No. 1 (deck edge) elevator. The latter check was made at 110 SRPM since maximum elevator vibration had been reported at this speed.

4. Results of measurements at the stern check during speed build-up are given in Table I, enclosure (2). This data has been plotted on Figures I through IV, enclosure (4). Although various components are present, especially during turns, the major components of interest are at propeller blade frequency, fourth order to SRPM. Since propeller shaft speed varied somewhat from nominal settings, especially during turns, the data is plotted on Figures I through I with recorded CPM 4 as abscissa rather than nominal SRPM. Amplitudes given are, in general, quasi-peaks and are all double amplitude. Original records are furnished for additional review, if desired, as (1) through (20) of enclosure (5). Instrument calibration (either channel) is given in enclosure (6). Chart paper speed was 5 mm/sec for slow (s) operation, 25 mm/sec for medium (m), and 125 mm/sec for fast (f).

5. Evaluation of these data indicates that there is no definite hull resonance condition at speeds 50 SRPM and above. A slight peak is evident in both the vertical and transverse directions at about 90 SRPM. This slight rise could be due, however, to anomaly in the experimental conditions or ship response. During the speed increase from astern to full power ahead there were a few cycles of vibration at increased amplitude at about 6.2 CPS, corresponding to a fourth order at 92 SRPM, which also might indicate a resonant condition. Still, such amplitude increases also occurred at other speeds during this build-up but are not reflected in the curve for incremental speeds. In any event, the resonance, if present, is of no serious consequence. Vibration is mild in free route up to 100 SRPM. Above 100 SRPM, amplitudes increase to a maximum of 21 mils in the vertical direction and to a much smaller degree in the transverse direction. It appears that a hull resonance is approaching in the vertical direction at full speed. Decks and bulkheads in areas throughout the ship respond to both the fourth order excitation and, primarily in the after part of the vessel, to the higher frequency components which are present in the wave form. Most difficulty from such vibration is experienced in the medical spaces where it is difficult to write and perform such duties as reading a microscope under full

power conditions. In addition, the rattling of joiner bulkheads, equipment, and material stowed in metal cabinets cause distracting noise condition throughout these spaces.

6. During turns, both the vertical and transverse fourth order vibration levels are materially increased. Vibration is generally greatest at the start of a turn. High levels do, however, often continue throughout the turn or redevelop after the initial levels have somewhat decayed. Ship vibration behavior is not uniform during turns. There is considerable variation in the amplitudes of the quasi-peaks. Approximate limits of the variations are drawn as dashed lines on Figures III and IV, enclosure (6). The full line in these curves represents an approximate mean behavior. It is quite evident from the data that vibration during turns is a forced vibration at propeller blade frequency and does not involve a full resonance. Excitation forces increase rather uniformly with speed but vary with different transient hydrodynamic flow conditions at the propeller with each individual turn.

7. Insufficient time was available during the second phase of the trials on 11 January to operate the ship and investigate the many items reported to be vibrating by the ship's force. A cursory review of reports which were submitted appeared to confirm the impression that local structures in the after part of the vessel responded to both propeller blade excitation and higher frequency vibration components at speeds above 100 SRPM. The forward and midship areas of the ship appeared quite free of vibration during steady course at all speeds but responded generally to propeller blade excitation during the turns. This response varies with location but is the maximum in the island structure and on the foremast. Reports of vibration submitted by ship's force are furnished as enclosure (7). Measurement efforts were confined, as previously indicated, to the main deck (centerline amidships), the bow (at 01 level), the island structure at 06 level, the deck edge elevator, and at representative deck areas in the medical spaces. Since full resonance was not experienced at lower speeds, the investigation on the second day was confined (except for the deck edge elevator) to full power operation at 117 nominal SRPM. Further check of the vibration levels of main propulsion units at full power was made, especially the condenser S.W. intake piping and connections.

8. Table II, enclosure (3), gives the results of the second phase investigation. Significant vibration on propulsion machinery components during straight ahead free route ship operation is in the fore and aft direction and is at propeller blade frequency. This is a forced vibration condition in which the maximum forcing frequency (at full power) is somewhat below the system natural frequency. Measurements previously obtained during dock trials of the vessel indicate a propulsion system natural frequency between

10 and 11 CPS. The ratio of maximum forcing frequency to the natural frequency is therefore about 0.75. This gives a minimum transmissibility of at least 2.0 at full power. This indicates the possibility of significant force amplification throughout the propulsion system. The relative motion between the turbine foundation and the reduction gear foundation, deduced from records (29) and (34), is about 15 mils double amplitude (D.A.). As shown by record (28), amplitudes of the fore and aft vibration did not materially increase during a hard turn to starboard.

9. During the first sea trial of the ship in the Shipyard, large vibratory motion was experienced across the flexible coupling which connects the main condenser S.W. intake pipe with the sea chest valve. Following that trial, three stiffening brackets were installed across the coupling to provide additional support. Additional hangers were installed on the intake pipe and fore and aft braces were installed from the after end of the condenser to the reduction gear foundation. All of these modifications were approved by Westinghouse Electric Corporation contractors for the main propulsion plant. Some effort was therefore expended during the second phase of this vibration trial to investigate presently existing conditions at this location. During straight ahead operations at full power a relative motion of 34 mils D.A. was measured (record 31) in the axial direction (F&A) across the flexible coupling. This condition remained the same during the hard right turn (record 32). A relative motion (also at propeller blade frequency) of 8 mm D.A. was measured in the transverse direction during the turn. Absolute fore and aft motion at the flexible coupling end of the intake pipe was about 41 mils D.A. Absolute motion at the intake pipe coupling flange at the condenser end was 33 mils D.A. (record 30). The fore and aft relative motion across the intake pipe was hence about 8 mils D.A. during straight ahead operations. During a hard right turn the transverse motion at the intake pipe flanges was also measured (record 33). Under this condition the motion at the condenser end of the pipe was about equally divided between fourth and about eighth order (to shaft RPM) components. The eighth order component was attenuated about one half over the pipe while the fourth order component was reduced only slightly. It is difficult to determine the relative motion across the pipe from the record obtained but, in general, it appears that the fourth order vibrations at either end are in phase and are subtractive. The eighth order components appear to be out of phase, however, and may therefore be additive across the pipe.

10. Vibration levels at the main deck, centerline, over bulkhead 63 were low (records 35 and 36). For straight course operation a vertical vibration at propeller blade frequency of 5 mils D.A. was measured. Transverse vibration under this condition was negligible. During a hard turn to port, the fourth order vertical remained at about 5 mils during the first part of the turn and then damped out to a negligible amount. The transverse vibration increased to about 4 mils D.A. at propeller blade frequency.

11. Amplitudes at the bow of the ship, 01 level on bow chock, were somewhat less than found at the stern (records 37 and 38). Frequency, again, was primarily fourth order to propeller SRPM. The vibration wave form was essentially free of the higher frequency components found at the stern. Considerable increase in amplitude in the transverse direction was measured during a hard turn to port. The peak level of vertical vibration remained essentially the same during the turn but there was more variation in amplitude than during the straight course run.

12. Amplitudes in way of the mast, 05 level, frame 63, were mild during straight course operation at full power (record 39) and vibration was at propeller blade frequency and free from higher frequency components. Amplitude was greatest in the transverse direction. During a hard left turn (record 40) the fourth order double amplitude in the transverse direction increased to 77 mils D.A. The corresponding vertical double amplitude was 13 mils. Vibration was observed in the mast during the turn but vibration measurements were not made. The motion was somewhat complex but appeared to be greatest in the transverse direction, with a nodal point approximately half way up the mast from the 07 level. The top of the mast was vibrating at high amplitudes. Although additional braces had previously been installed on electronic installations at the 06 level, vibration on these components was still observed during the turns.

13. Limited time prevented wide coverage of deck and bulkhead vibration in the medical spaces. Measurements were taken at the foot of the X-ray machine (records 41 and 42), on X-ray machine components (record 41), and at the foot of one operating table (records 43 and 44). Maximum amplitudes on the deck at the X-ray machine, in vertical direction, at propeller blade frequency was 34 mils. Fluoroscope support was secured to prevent damage. Vibration at the operating table was not as severe as at the X-ray machine, but was still of sufficient magnitude to handicap work and was considered objectionable at full power and during turns. There was general vibration of decks and bulkheads throughout the medical spaces.

14. An attempt was made to determine if 35° rudder was required to induce the high levels of vibration during turns. Instruments were re-installed at the stern chock, main deck, centerline, and turns were made to port with 15° and 10° rudder angles. The turn with 15° rudder angle produced amplitudes about the same as with 35° rudder. The turn with 10° rudder angle produced amplitudes somewhat less than with higher rudder angles.

15. Measurements were taken on the forward, outboard corner of the deck edge elevator at a nominal speed of 110 SRPM (records 48 and 49). The elevator was at the flight deck level. A maximum of 70 mils D.A. vertical, was measured during the turn.

16. It is concluded that vibration levels are generally acceptable during straight ahead operation of the vessel up to speeds of 100 SHPM for this ship when operated at a displacement of 2,000 tons under its full load displacement. Above that speed, local structural response occurs throughout the after part of the ship with a maximum measured double amplitude vibration of 21 mils, not only to fourth order, propeller blade frequency, excitation but to the higher frequency components induced by propeller and hydrodynamic action. The scope of this survey was not sufficiently broad to establish any information on the modes of vibration of the hull. Vibration levels during turns increase quite rapidly above 90 SHPM and become maximum at full power. Greatest response occurs in the island structure and on the foremast. There is 15 mils relative motion across the reduction gear case to the turbine foundation and between other components which may be causing high levels of stress reversal. There appeared to be no abnormal noise in gears or other components associated with the vibration.

17. It is believed that the high vibration exciting forces during the turns is caused by the large unbalance in propeller blade forces from the differential in water velocity introduced at the plane of the propeller blades when the rudder is put over.

18. With respect to general hull vibration it is noted that the vibration trials were limited in scope as to instrumentation for a complete hull survey and that measurements were only taken with the ship at available displacement. It is also noted that vibration amplitudes recorded under the above conditions at the stern chock were a maximum of 21 mils double amplitude when operating at full power. Reference (b) indicates that no standards of comparison for acceptable vibrations have been established but includes a chart which was developed from hull vibration measurements on naval vessels at Boston Naval Shipyard. Comparison of measurements taken on LPH2 with this chart at full power range from "tolerable" to "not good" at stern chock.

Review of vibration data available on the Maritime Commission Mariner' type ship which is similar to and was used as the basic design for developing the USS IWO JIMA (LPH2) indicates that this class of ship has a vibration amplitude on the stern of 25 mils double at 110 shaft turns with a four bladed propeller. Vibration characteristics of this ship were reported as varying with different loading conditions and in general were considered as being almost completely vibration free. In view of the foregoing no recommendations are included for immediate corrective action. Review will be made of items reported as vibrating excessively and will be stiffened and corrected as required during the post shakedown availability. Shipyard personnel will be present at final acceptance trials to review items and prepare plans for corrective action.

(270/275)
LPH2/9080
Z-23259

19. If it is considered that amplitudes of vibration recorded above are not acceptable, it is recommended that more detailed information on the vibration characteristics of this ship be obtained with the view of possible selection of a more suitable number of propeller blades to reduce the amplitudes of vibration experienced at the stern. There is some indication from data obtained that a three bladed propeller may reduce the amplitudes experienced but in view of limited overall knowledge of the elastic curve for the whole length of the ship it is not recommended that this be tried until more data is obtained. It is suggested that David Taylor Model Basin obtain complete vibration data on the ship during the Bureau of Ships performance and special trials scheduled in April 1962. It is suggested that these trials be conducted in lieu of the Fuel Economy and Heat Balance trials since similar complete trials with calibrated meters were conducted by this Shipyard during Preliminary Acceptance Trials.

20. Data obtained on turbine and reduction gear vibration as reported in paragraph 8 will be furnished Westinghouse Electric Corporation with a request for their comment. Since the installation is the same as existing installations on the Mariner type ships, it is expected that they will have service data to assist in evaluating the effect, if any.

Copy to: (less encls (1), (5),
(6), (7), (8))
CO USS IWO JIMA (LPH2)
COMPHIBPAC
COMPHIBPAC, CAPT Foster
NAVSHIPYDPHILA
NAVSHIPYDLBEACH
DTMB

D. K. ELA
By direction

NAVSHIPYDBREM Codes 275(2), 270, 250, 260,
244, 247, 211

TABULAR DATA 1300-1307

SUBJECT: LPH2 Vibr Final Data

TABLE I

DATE: 1/10/62

Transducers located on stern chock, main deck, centerline

SHEET NO. 1 of 2

Encl (2) PSNS ltr LPH2/9080 T-23259 dtd (270/275)

Time	Record No.	Rudder	SRPM	VERT CPM	VERT mm	VERT mils/mm	VERT Mils D.A	TRANSV CPM	TRANSV mm	TRANSV mils/mm	TRANSV Mils D.A.	Remarks
	1	35°L	50	197 (4)	2.5	3.1	8	—	NEG		NEG	
	2	0°	50	192 (4)	NEG	—	NEG		NEG		NEG	
	3	35°R	50	198 (4)	2.5	3.1	8		NEG		NEG	
	4	0°	60	240 (4)	Neg	—	Neg	240 (4)	Neg		Neg	
	5	35°L	60	200 N	2.0	3.1	6	450 (8)	Neg		Neg.	
		Return to Course	"	200	3.5	3.1	11		Neg			
1342	6	35°R	"	240 (4)	1	2.6	2	240 (4)	1	2.6	2	
1355	7	0°	70	288 (4)	1	2.3	2	282 (4)	Neg		Neg	2 Component wave
	8	35°	"	282 (4)	7	2.3	16	282 (4)	2.5	2.3	6	Max at Steady turn
1418	9	35°R	"	282 (4)	3	2.3	7	282 (4)	2	2.3	5	
1428	10	0°	80	342 (4)	1	2.0	2	342	1½	2.0	3	
1438	11	35°L	"	276 (4)	5	2.4	12	276	2	2.4	5	
	12	35°R	"	300 [illegible]	3 / 1	2.2 / 1.1	6	300	1.5	2.2	3	
		Return to Course		262 (4)	4	2.5	10	262 (4)	1.5	2.5	4	Return to Course
1519	13	0°	90	360 (4)	3	1.9	6	360 (4)	2	1.9	4	
	14	35°L	90	330	9	2.1	19	330	8	2.1	17	
1538	15	35°R	90	330	3	2.1	6	330	7	2.1	15	
	16	0°	100	400 (4)	3	1.7	5	400 (4)	2	1.7	3	
1554	17	35°L	"	372 (4)	10	1.9	19	372 (4)	9	1.9	17	
1603	18	35°R	"	372 (4)	9	1.9	17	372 (4)	3	1.9	6	
1622	19	0°	110	450 (4)	9	1.5	14	450 (4)	4	1.5	6	
	20	35°L	"	456 (4)	13	1.5	19	450 (4)	17	1.5	25	
	21	35°R	"	420	11	1.6	18	420	17	1.6	27	

NAVY-DPPO 13ND BREM, WN

CALCULATED BY: D.C. Middleton

CHECKED BY:

TABULAR DATA 1300-1707 LPH2 Vibr. Trial Data

TABLE I

DATE 1/10/62

SUBJECT Transducers located on stern chock, main deck, centerline

SHEET NO. 2 of 2

Time	Rec No	Rudder	SRPM	VERT CPM	VERT m m	VERT mils/mm	VERT mils D.A.	TRANSV CPM	TRANSV m m	TRANSV mils/mm	TRANSV mils D.A.	Remarks
	22	0°	117	474 4	15	1.4	21	474 4	4	1.4	6	
	23	35° L	"	450 4	22	1.6	35	432 4	17	1.6	27	
	24	35° R	"	432 4	8	1.6	13	432 4	17	1.6	27	
	25	FULL AHEAD - FULL ASTERN		292	18	2.2	40	296	19	2.2	42	
	26	FULL ASTERN - FULL AHEAD		470	15	1.5	23	470	5	1.5	8	no definite resonance indicated

NAVY-DPPO 13ND BREM. WN

CALCULATED BY E.C. Middleton

CHECKED BY

TABULAR DATA 1300-1707

SUBJECT LPH 2 Vibr. Final Data TABLE II DATE 1/11/62

117 SRPM SHEET NO. 1 of 3

Rudder	REC. No.	TIME	LOCATION	DIR.	CPM	mm	mils/mm	D.A. Mils	Remarks
0°	27		Thrust Bearing (Gear Case)	F&A	450	10	1.5	15	
			Aft end of Gear Case	"	"	5.5	1.5	8	
35°R	28		Thrust Brg (Gear case)	"	414	11	1.7	19	
			Aft end of Gear Case	"	"	5	1.7	9	
0°	29		Red Gear Fdn (Fwd)	"	468	7	1.5	10	
			" " " (aft)	"	"	6	1.5	9	
0°	30		(A) S.W. Cond. Intake Flg at Cond.	F&A	468	22	1.5	33	In
			(B) " Intake Pipe @ Flex Coupling	"	468	27	1.5	41	Phase
0°	31		(A) " " Intake Valve Flg.	axial (F&A)	468	5	1.5	7	In
			(B) " Intake Pipe @ Flex Coupling		468	27	1.5	41	Phase
35°R	32		(A) " Do #31 Flg	F&A	468	6	1.5	9	In
			(B) (across	"	468	27	1.5	41	Phase
			(A) coupling)	T	434	7	1.6	11	In
			(B)	T	434	12	1.6	19	phase
35°R	33		(A) Do #30	T	850 434	15 8	0.8 1.6	12 13	Complex
			(B)	T	850 434	8 6	0.8 1.6	6 10	wave
0°	34		Turbine Fdn (Fwd)	F&A	468	17	1.5	25	
			" " (aft)	F&A	468	17	1.5	25	
0°	35		Main Dk R (Fr 63)	Vert	468	3	1.5	5	
			" "	T	negligible		—	neg.	
35°L	36	1005	Do #35	Vert	455	3	1.5	5	
				T	455	2.5	1.5	4	

Encl (3) to PSNS ltr (270/275) LPH2/9080 T-23259 dtd

NAVY-DPPO 13ND BREM, WN

CALCULATED BY D.C. Middleton CHECKED BY

TABULAR DATA 1310-1707

SUBJECT LPH 2 Vibr. Trial Data TABLE II DATE 1/11/62

117 SRPM SHEET NO. 2 of 3

Rudder	Record No.	Time	Location	Dir	CPM	mm	Mils/mm	Mils	
0°	37		01 Level - Stern (Check)	Vert	474	8	1.5	12	
				T	474	3	1.5	5	
35°L	38	1020	Do #37	Vert	468	7	1.5	10	
				T	420	11	1.6	18	
0°	39		Deck @ 06 level board against the mast, Fr 63	Vert	468	2.5	1.5	4	
				T	468	7	1.5	10	
35°L	40		Do #39	Vert	432	8	1.6	13	
				T	432	48	1.6	77	
0°	41		X Ray machine x Deck at aft (S) foot	Vert	468	23	1.5	34	See note (over)
				T		neg		neg	
35°L	42		Do #41	Vert	468	13	1.5	20-35	Complex wave
				T		3	1.5	5	
0°	43		Foot operating table Const. 01-118-0L	Vert	468	9	1.5	13	
				T	468	2.5	1.5	4	
35°L	44		Do #43	Vert	468	10	1.5	15	complex wave
				T	468	5	1.5	8	
0°	45		Fantail, Mn Deck	Vert	468	15	1.5	22	
				T	468	3	1.5	5	
15°L	46		Do #45	Vert	474	22	1.4	31	
				T	468	10	1.5	15	
10°L	47		Do #45	Vert	474	20	1.4	28	
				T	474	8	1.4	11	

NAVY-DPPO 13ND BREM, WN.

CALCULATED BY D. C. Middleton CHECKED BY

X-Ray Machine Components

Flouroscope Support

TRANSV 66 mils D.A

Vert 51 mils D.A

Top of table (Vert) 41 mils D.A

$\Big\}$ 468 C.P.M.

SHEET NO.

DATE

TABULAR DATA 13ND-1707

SUBJECT LPH-2 Vibr. Trial Data TABLE II

110 SRPM

DATE 1/11/62

SHEET NO. 3 of 3

Rudder	Record No	Time	Location	Dir.	CPH	mm	mils/mm	Mils
0°	48		Fwd Outlet corner Elev #1	Vert	440	8	1.6	13
				T	440	5	1.6	8
35°L	49		Do. #48	Vert	420	44	1.6	70
				T	420	13	1.6	21

NAVY-DPPO 13ND BREM.WN

CALCULATED BY D.C. Middleton CHECKED BY

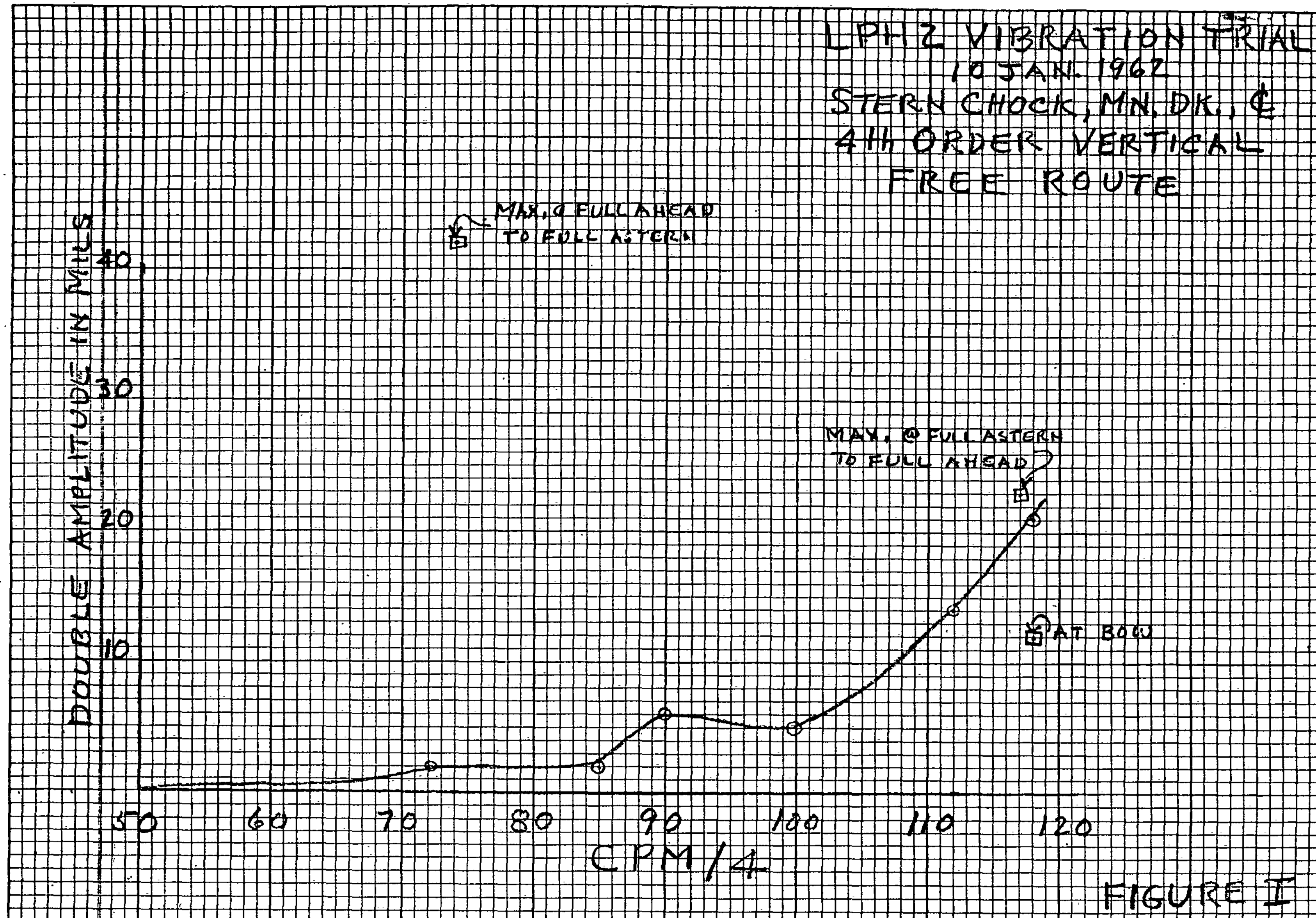


FIGURE I

Encl (4) to PSNS ltr (240/275) LPH2/9080 T-23259

LPH2 VIBRATION TRIAL
10 JAN. 1962
STERN CHOCK, MN. DK., ℄
4th ORDER TRANSVERSE
FREE ROUTE

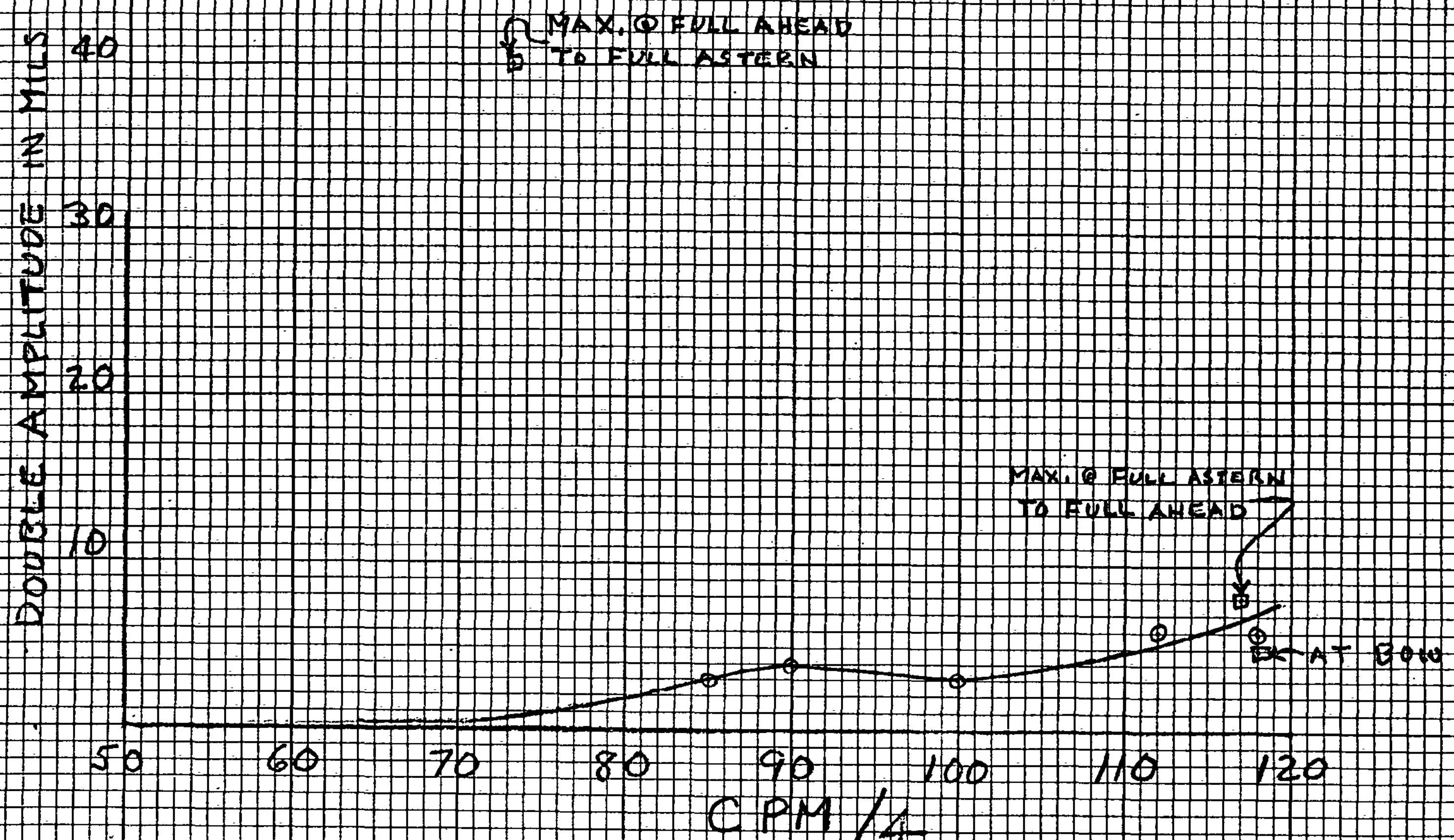


FIGURE II

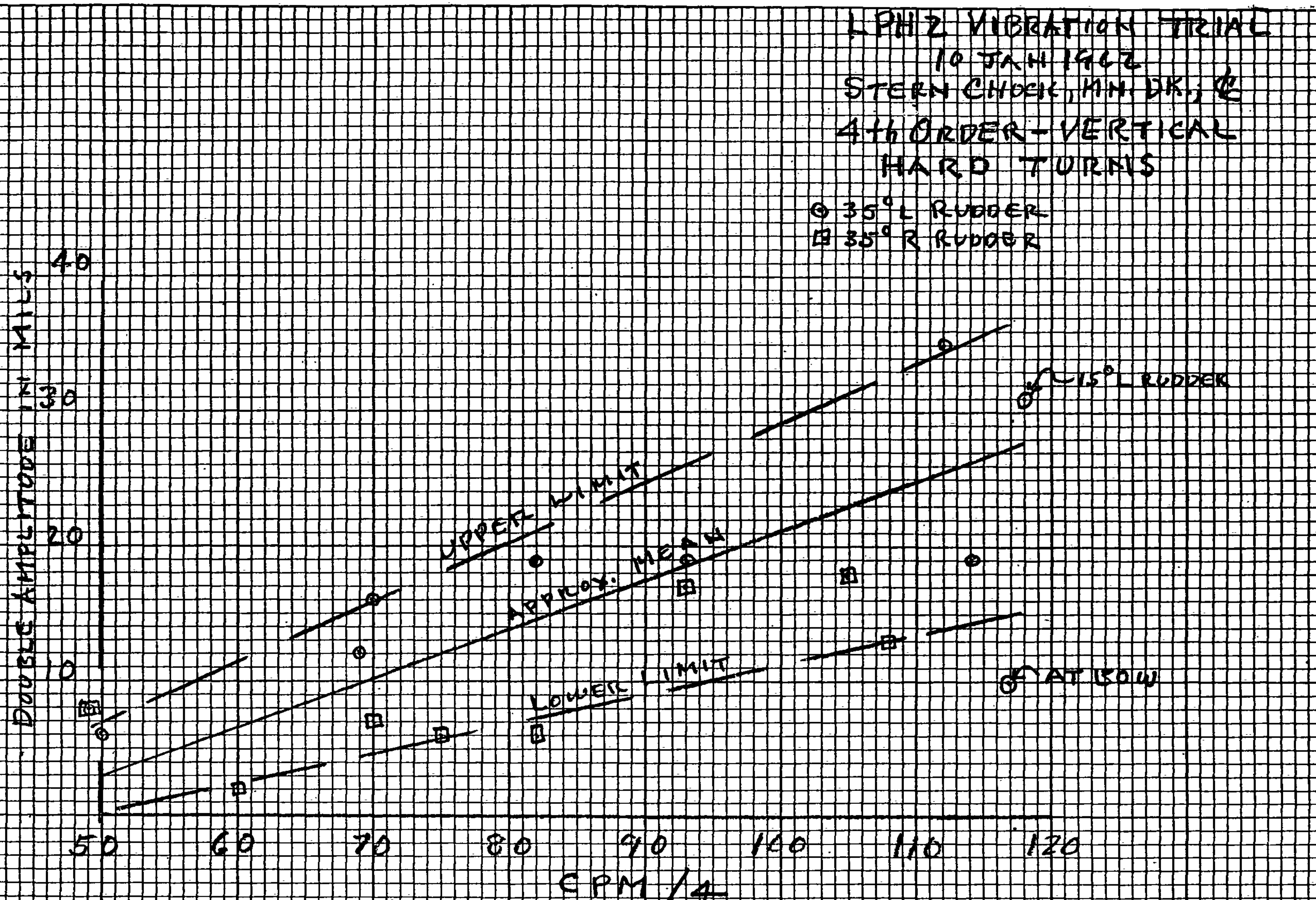

LPH2 VIBRATION TRIAL
10 JAN 1962
STERN CHOCK, MN. DK., ℄
4th ORDER - VERTICAL
HARD TURNS
⊙ 35° L RUDDER
⊡ 35° R RUDDER
15° L RUDDER
AT BOW
UPPER LIMIT
APPROX. MEAN
LOWER LIMIT
DOUBLE AMPLITUDE IN MILS
40
30
20
10
50
60
70
80
90
100
110
120
CPM / 4

FIGURE III

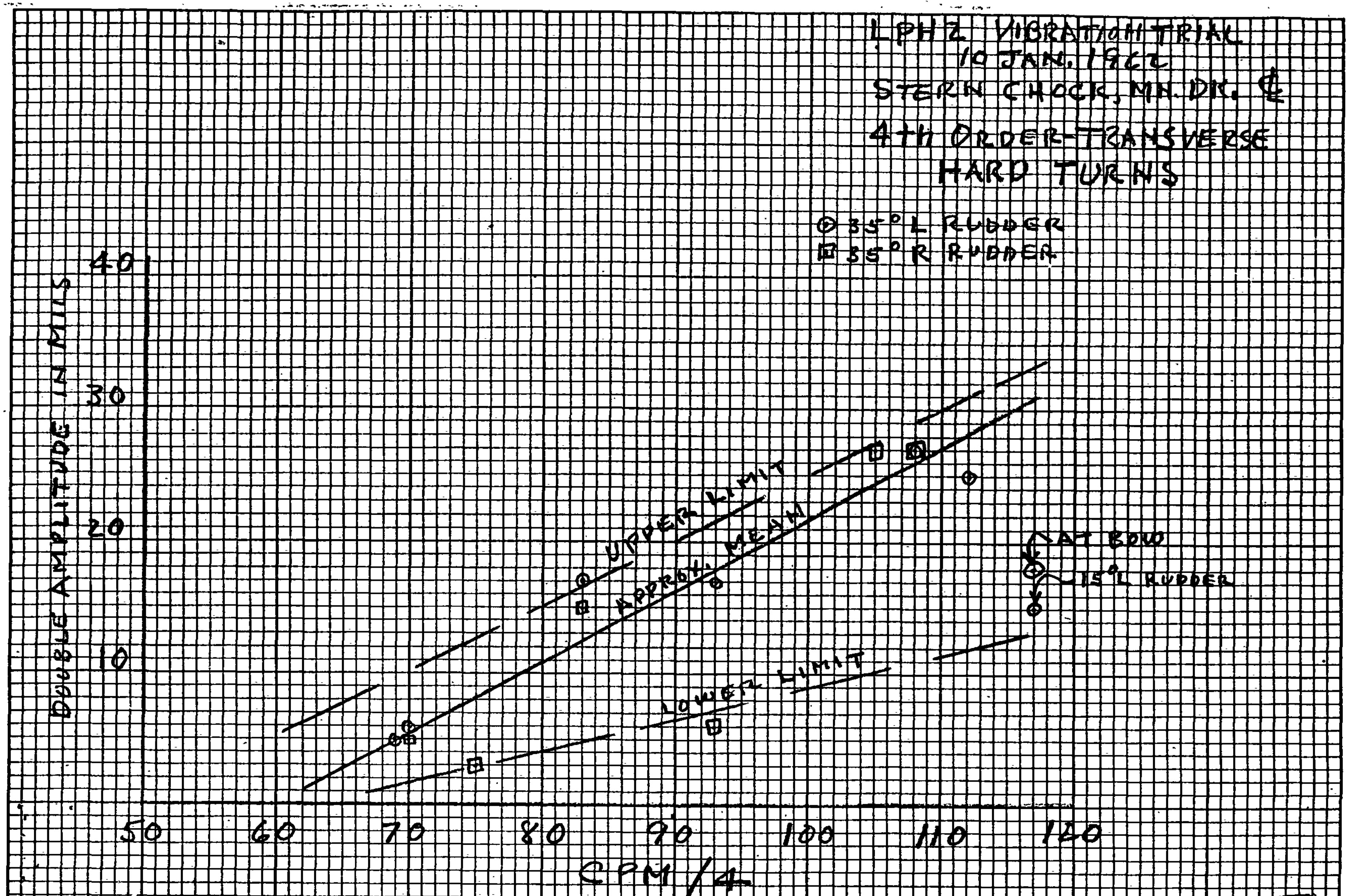

LPH2 VIBRATION TRIAL
10 JAN, 1962
STERN CHOCK, MN. DK. ℄
4th ORDER-TRANSVERSE
HARD TURNS
⊙ 35° L RUDDER
⊡ 35° R RUDDER
UPPER LIMIT
APPROX. MEAN
LOWER LIMIT
AT BOW
15° L RUDDER
DOUBLE AMPLITUDE IN MILS
40
30
20
10
50
60
70
80
90
100
110
120
CPM/4

FIGURE IV

1300-PSMS-1023/34 (Rev. 6-61)

SHIP	SHIP	JOB ORDER No.	DATE
	USS KEARSARGE (CVS33)	CVS33-800-275-35	2-20-62

FOLLOW-UP/RELEASE NO.	PREPARED BY	SUPERVISOR	TEL. NO.
	D. C. Tufts	J. M. Watson	9231

SUBJECT — DESIGN DIV. JOB ORDER

USS KEARSARGE (CVS33)
No's. 1 and 2, 400 Cycle, Motor Generator Sets; vibration of

Ref: (a) Ship's Work Request 344-61-E

(b) MIL STD 167

1. Vibration measurements were made on the No. 1 and No. 2, 400 Cycle, Motor Generator sets, as requested by reference (a). Vibration measurements were made only for no-load operation of the generators. The maximum vibration at the bearing housings was 2.25 mils double amplitude (DA) on the No. 1 motor generator, and 2.0 mils DA on the No. 2 motor generator. The allowable amplitude for a 3555 RPM motor generator is 1.5 mils DA, see reference (b).

2. Since vibration of both motor generator sets is slightly above the allowable amplitudes as specified by reference (b), and in view of the ship's report of bearing failures in the past, the following recommendations are made:

a. Both motor generator sets be taken to the Shop for repairs, including balancing and bearing replacement.

b. Both motor generator sets shall be operated on a soft pad in the Shop prior to repair. Notify Code 275 so vibration measurements can be taken.

c. Both motor generator sets be dynamically balanced to a precision balance of less than .5 mils DA residual vibration, see MIL SPEC MIL-M-17059. Notify Code 275 so vibration measurements can be taken.

d. Remount the motor generator sets on the ship, using Fabreeka Pads as per CV34 USS ORISKANY Plan P. S. File No. 4128. Notify Code 275 so vibration measurements can be taken.

e. Provide electrical bonding, as required.

for J M Watson
E. C. MIDDLETON
Head, Test Branch

C/233/227: (Bi 21.1) Deferred due to lack of funds. Please issue for record purposes and provide C/212 with estimated costs. Matthews [illegible] 2/28/62

COPY TO
275(3), 270, 244, 212(5), 233, 227

CODE	275	270	244	212	227	233			864	275
INITIAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]
DATE	2/20	2/21	2/20	2/28/62	[illegible]	3/1				

PSND-PSNS 9?? /34 (Rev. ?-?1) JOB ORDER No.

SUPPLY NO.	SHIP	MEMO NO.	DATE
	USS TICONDEROGA (CVA14)	CVA14-800-275-1	28 February 1962

RELEASE NO.	PREPARED BY	SUPERVISOR	TEL. NO.
	L. C. Tufts	J. M. Watson	9231

SUBJECT: USS TICONDEROGA (CVA14) — DESIGN DIV. JOB ORDER 16420-8001-01 P68

Vibration of Ship's Service Generators; report of investigation

Ref: (a) PSNS Test Memo No. T-23293
(b) Ship's Work Request No. 287-62-E
(c) MIL-STD-167

1. Reference (a) requested a vibration investigation of No's. 1, 3, and 4 ship's service generators. This investigation was accomplished, while the ship was underway from Bangor to the Shipyard, on 24 February 1962. The ship requested that a vibration check of the No. 2 generator also be made. A check of the No. 2 generator was made, concurrently, with the checks made on the No's. 1, 3, and 4 generators. Generator load was changed by shifting ship's load between generators.

2. Vibration measurements were made at the end of the exciter, and on the foundation below the exciter. In all cases, vibration frequency was first order to the generator RPM. The amplitudes of vibration are given below, in mils double amplitude (DA).

GENERATOR

	1			2			3			4		
Direction of Vibration %Load →	0	50	100	0	50	100	0	50	100	0	50	100
Vertical (Generator)	2	1/2	1	3	4	4	7	4	3		1.5	6
Transverse (Generator)	2	2	2	10	10	10	14	13	10		5	5
Longitudinal (Generator)	1/2	1	1	2	2	3	2	2	1		1	4
Vertical (Foundation)	1	1	1.5	4	5	4	6	5	3/4		2	3
Transverse (Foundation)	3	3	4	5	5	4	6	6	6		1.5	4
Longitudinal (Foundation)	0	1	1.5	2	1	1	1/2	1.5	3/4		1	1

Measurements were also taken on the fwd turbine bearing and on the reduction gear case. In all test conditions, these amplitudes were less than 1 mil DA.

3. The above measurements indicate the following:

a. The vibration on the No. 1 generator is only slightly above the allowable level of 1.4 mil DA, reference (c)

b. Vibration on the turbine and reduction gears is within the allowable 1.4 mils DA, reference (c).

COPY TO: 275(3), 270, 244, 212(3), 233(2), 510, CVA14(3), ~~350W, 376~~ ~~331(3)~~ Walker 232(1) 51, 38, 350W

ROUTE										
CODE	275 for 270	244	212	239A	233			864	275
INITIAL		RMH							
DATE	3/2	3/2/62	3/5	5/14/62	5/6/62	5/16			

1-8

c. Vibration on the exciter on Generators 2, 3, and 4 is excessive. There are indications of misalignment and/or unbalance.

4. It is recommended that the alignment of the No's. 2, 3, and 4 ship's service generators' components be checked, and that the exciters be balanced to bring the vibration amplitude to within 1.4 mils DA, as specified by reference (c).

5. A high frequency noise, excessive in level, was emitted from the reduction gears of Generators 1, 3, and 4 when the generators were operating under full load. This noise decreased as load was decreased until it was not discernable above other noises during no-load operation of the generators. The same noise was emitted from set No. 2, but did not seem excessive. It is believed that this noise may be caused by misalignment, excessive wear, or hobbing error on the main, pinion, or lubricating pump gears. It is recommended that production work include opening and inspecting the gear units for Generators 1, 3, and 4, and correcting any deficiencies found.

6. It is requested that Code 273 be informed when these generators are ready for operation, following re[illegible]r. A check of vibration will then be made to determine the effectiveness of corrective action, and gear noise will be more fully investigated by instrument methods if excessive noise persists.

E. C. Middleton, PE
E. C. MIDDLETON
Head, Test Branch

C/233: Issue for information
Matthews 4/206 9/212B
5/11/62

Note: Exciters for #2, 3 + 4 S.S. GEN. have been Removed AND Farmed out for Repairs & balancing J.O. 16420-6103
H GRAY C/233

350(3)

SHIPALT NO.	SHIP	MEMO NO.	DATE
	USS COLUMBUS (CG-12)	CG12-800-275-10	4 April 1962
	PREPARED BY	SUPERVISOR	TEL. NO.
	TUFTS	WATSON	9231

SUBJECT

Vibration of Ship Service Generator No. 3; report of investigation

Ref: (a) MIL-STD-167

1. Vibration measurements on Ship Service Generator No. 3 were requested by Shop 38. These measurements were taken on 3 April 1962, with generator loads of 0%, 50% and 100%.

2. Vibration measurements were made at the end of the exciter, on the reduction gear case, and at the end of the turbine. In all cases the vibration frequency was first order to the generator RPM and amplitudes did not vary with load. The amplitudes of vibration are given below, in mils double amplitude (D.A.)

Direction of Vibration	Location of Measurements		
	Exciter	Reduction Gear	Turbine
Vertical	3	2	1
Transverse	3	2	2

3. The maximum allowable vibration at bearing housings of this generator is 3.5 mils (D.A.) as stated in reference (a). Although the 3.0 mils recorded on the exciter is a borderline case, the unit is considered acceptable. It is recommended however, that a more precise balance of generator and exciter be obtained during the next shop availability of these units.

R McCutter
E. C. MIDDLETON
Head, Test Branch

COPY TO: 275(2), 270, 58, SHOP 38, 213, 233, S.F

CODE	275	270	244	243	239A	233	232	864	275
INITIAL	RCM	[illegible]	WHR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
DATE	4-10	4/9	4/9	4/10	4/10/62	4/12/62	4/12		

270/275
CVS33/9410

27 APR 1962
T-23384

AIR MAIL

From: Commander, Puget Sound Naval Shipyard
To: Commander, Naval Air Force
U. S. Pacific Fleet
U. S. Naval Air Station
San Diego 35, California

Subj: USS KEARSARGE (CVS33), Vibration Survey of SPN-8 Platform; report of

Ref: (a) COMNAVAIRPAC msg 310233Z Mar
(b) Specification MIL-STD 167, Shipboard Vibration

1. A vibration survey of the SPN-8 radar platform on USS KEARSARGE (CVS33) was requested by reference (a). The survey was accomplished during the 80% full power run of the INSURV trials on 9 and 10 April 1962.

2. Vibration of the SPN-8 platform was measured at the junction of transverse and longitudinal stiffening, on the underside of the platform, about one foot aft of the antenna center. Measurements were also made on the island structure at the attachment of SPN-8 platform longitudinals, and within the SPN-12 radar room, frame 106, starboard side, at the junction of bulkhead stiffening and the 06 deck. The displacement double amplitudes (D.A.) and frequencies observed during ship operation at speed increments between 150 and 239 SRPM are recorded in the table below:

Pickup Location	Pickup Direction	Ship Speed in Shaft RPM 150		170		190		210		220		230		239		80% Full Power Turns (239 RPM)	
		F	DA	F	DA	F	DA	F	DA	F	DA	F	DA	F	DA	F	DA
SPN-8																5	95
Platform	Vertical	18	3	18	9	18	7	18	16	18	16	18	12	18	12	18	45
SPN-8		6.5	2									17.5	2			6.5	160
Platform	Athwartship															10	35
		10.5	3	10.5	6	12.5	5	18	2	15	2	25	2	17.5	3	24	18
SPN-8								10	1								
Platform	Longitudinal	10	3	10.5	3	10.5	2	18	3	12	3	15	3	15	2		
Island at																	
Platform	Vertical	15	1	14	2	12.5	2	14	2	14	1	14	2	14	2		
Island at		13	1	15	2	7	6	14	2	14	3	17.5	1	14	2		
Platform	Athwartship							14	1	14	3	15	3	15	2		
AN/SPN-12																	
Equip.Rm.	Athwartship	6.5	2	14	1	6.5	5	3.5	10	3.5	5	7	2	3.5	10		
" "	Vertical													15	3		

F -- Frequency in cps.
DA - Displacement in mils double amplitude.

3. The vibration amplitudes recorded above for straight course operation are within the acceptable limits for shipboard vibration defined in basic specifications, reference (b). The 160 mils (D.A.) transverse vibration at 6.5 cps, recorded during turns at 239 SHRM, is about three times greater than levels specified by reference (b).

W. L. CARLSON
By direction

Copy to:
BUSHIPS
NAVSHIPYDBREM Codes 275, 270, 273,
248, 244, 212

PLANNING DEPARTMENT MEMO
13ND-PSNS-9020/34 (Rev. 6-61)

JOB ORDER No.

	SHIP	MEMO NO.	DATE
	USS BRINKLEY BASS (DD887)	DD887-275-800-69	2 May 1962

REFERENCE NO.	PREPARED BY	SUPERVISOR	TEL. NO.
	D.C. Tufts	J.M. Watson JMW	9231

SUBJECT: USS BRINKLEY BASS (DD887)

DESIGN DIV. JOB ORDER

Report on DASH SRT discrepancy; excessive noise from 400 cycle motor generator set

Ref: (a) Design action request of 4-19-62, file 72.
(b) General specifications for ships section S1-10

1. Noise level measurements requested by ref (a) were taken in the DASH hanger near the 400 cycle MG, and in the Executive Officer's stateroom which is located just below the MG set.

2. The noise levels measured in both the DASH hanger and in the Executive Officer's stateroom are within the limits of reference (b). It is doubtful that additional repair work on the motor-generator would appreciably reduce its noise levels since variable speed gears of this type are inherently noisy.

3. No corrective action is recommended.

Edwin C Middleton
E. C. MIDDLETON
Head, Test Branch

No action required. Issued for info only.

COPY TO: 275(3), 270, 272, 253, 86, 210 (2), 244 244.7B, 235 RC 350(3)

ROUTE CODE										
CODE	275	270	200	248	244	213	239A	235	864	275
INITIAL	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	md	CD		
DATE	5/2	5/2		5/3	5/4		5/7/62	5/8		

RW.

1-2

DEPARTMENT MEMORANDUM

13ND-PSNS-9023 (Rev. 6-61)

JOB ORDER No.

SERIAL NO.	SHIP	MEMO NO.	DATE
	USS KEARSARGE (CVS33)	CVS33-404-275-40	5-2-62

RELEASE NO.	PREPARED BY	SUPERVISOR	TEL. NO.
	J.M. Watson		9231

DESIGN DIV. JOB ORDER

SUBJECT

USS KEARSARGE (CVS33)
Noise survey of AN/SPS-43A Antenna Turntable

1. Object of Test:

Testing was undertaken to measure and determine cause of excessive noise in the radar antenna turntable.

2. Methods of Testing:

Vibration data was tape recorded for three orthogonal planes at the mount. Visual and audible observations were made from the base of the antenna support structure. The testing was done for all operational modes of the turntable at low ships speed in calm water.

3. Results:

a. Wind loading of the antenna varied turntable noise level and character.

b. The AN/SPS-43 turntable had a considerably higher noise level than other nearby radar installations.

c. Random vibration of turntable for clock-wise rotation was higher than it was for counter-clockwise rotation in the horizontal plane (plane of bull gear).

RPM	MODE	ROTATION CHANGE	Δ DB
7½	Vert.	CCW → CW	-1
7½	Trans.	CCW → CW	+5
7½.	Long.	CCW → CW	+5

d. Increases in antenna rotational speed caused large noise increases.

RPM CHANGE	MODE	ROTATION	Δ DB
0 → 7½	Trans.	CW	+17
0 → 7½	Long.	CW	+22
0 → 7½	Vert.	CW	+27
7½ → 15	Vert.	CW	+ 4
7½ → 15	Long.	CW	+ 4

e. Spectrum analysis of vibration data indicated the major components of generated noise existed at bull gear tooth frequency.

COPY TO

275(3), 270, 244 273(5) S-? 330(3)

ROUTE CODES

CODE	275	270		273	248	244	212		864	275
INITIAL	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]			
DATE	5/4	5/7		5/7	5/8	5/8/62	5/14		6	

1-2

ANTENNA SPEED	BULL-GEAR TOOTH FREQ	VIBRATION MODE	SPECTRUM CENTER FREQ	APPROX HARM	SPEC LEVEL (db//g)
7½ rpm	160 cps	Trans.	350 cps	2nd	-58
7½	160	Trans.	600	4th	-35
7½	160	Vert.	1000	6th	-65
7½	160	Long.	1000	6th	-65
7½	160	Trans.	1050	7th	-28
7½	160	Long.	1450	9th	-69
7½	160	Vert.	1500	9th	-65
15	320	Long.	1675	5th	-48
15	320	Vert.	2100	7th	-48
15	320	Long.	3800	12th	-40
15	320	Vert.	4075	13th	-37

(Ambients are more than 30 db below spectrum level.)

4. Conclusions:

a. The turntable bull and pinion gear are the probable source of excessive noise. Limits of acceptability for this noise are not provided in any known specifications.

b. The noise produced by the turntable is not detrimental to voice communication.

c. Turntable noise and vibration are not apparent in compartments adjacent to antenna installation.

d. This antenna turntable is considerably more noisy than other radar turntables observed on the ship.

e. No objectionable electronic interference has been traced to the turntable vibration.

5. Recommendations:

a. The turntable assembly should be inspected for gear tooth wear and other mechanical deficiencies at the ship's next availability. Test findings do not constitute a requirement for immediate correction.

b. It is recommended THAT ~~the cognizant~~ design code 273 initiate action with the Bureau of Ships to provide more detailed specifications for antenna drive gears and their allowable noise levels.

E. C. Middleton, PE

E. C. MIDDLETON
Head, Test Branch

SHIP	JOB OR SER. NO. / SPEC NO.		DATE
TICONDEROGA (CVA14)	CVA14-800-275-2		6-20-62
PREPARED BY	SUPERVISOR		TEL. NO.
W.J. Beckman	J.M. Watson		9231

DESIGN DIV. 800 ORDER

USS TICONDEROGA (CVA14)
Vibration in Ship Service Turbogenerators - Post Overhaul

Ref: (a) Planning Memo CVA14-800-275-1
(b) Test Memo CVA14-807-23421
(c) Mil-Std-167
(d) 1250 KW AC-SS-TG NAVSHIPS 361-0010

1. Reference (a) noted excessive vibration on turbo-generators 2, 3, & 4 that was found by pre-overhaul testing. These machines were subsequently repaired by contractor, and post-overhaul vibration tests were conducted in accordance with ref (b). These tests were completed on turbo-generators 2 and 3, June 15, 1962. Turbo-generator #4 was not ready for testing.

2. Vibration frequency and amplitude were measured at zero and 24% rated KW load. Measurements were made at accessible bearing locations by use of a G.E. vibration indicator and an Askania vibrograph. The following table indicates the results of vibration measurements.

TABLE I

TG	LOCATION	% KW LOAD	FREQ CPS	MODE	AMPLITUDE MILS (DA)
#2	EXCITER BRG	0	53	V	2
	"			L	1
	"			T	6
	PEDESTAL BRG			V	1
	"			T	2
	REDUCTION GEAR			V	½
	"			T	½
	EXCITER BRG		60	V	2
	"			L	2
	"			T	8
	PEDESTAL BRG			V	1
	"			T	½
	EXCITER BRG	24%		V	2
	"			L	3
	"			T	8
	PEDESTAL BRG			V	1
	"			T	2
	#1 BRG				LESS THAN 1
#3	EXCITER BRG	0	60	V	2
	"			L	2
	"			T	13
	PEDESTAL BRG			T	3
	REDUCTION GEAR			V	1

COPY TO: 275(3), 270, 244, 212, 233, S-10, C/212B(2) 233 232, 51, 38, 350

CODE	275	270	248	244	212	239A	233		864	275
INITIAL									S	
DATE					6/26		6/27		6/27	

LOCATION	% KW LOAD	FREQ CPS	MODE	AMPLITUDE MILS (DA)
REDUCTION GEAR	0	60	T	2
#1 BRG			V	1
"			L	1
"			T	2
EXCITER BRG	24%		V	4
"			L	2
"			T	13
PEDISTAL BRG			T	2
REDUCTION GEAR			V	2
"			T	2
#1 BRG			V	½
"			L	½
"			T	2

LEGEND: V - VERTICAL
L - LONGITUDINAL
T - TRANSVERSE

3. Data listed in Table I indicates that:

a. The exciter on turbogenerator #2 is above ref (c) tolerances in the three vibrational planes tested. The exciter bearing is running 600% above limits in the transverse vibrational plane.

b. The exciter on turbogenerator #3 is over acceptable limits in all vibrational planes. The transverse mode on the exciter bearing is exceptionally poor with amplitudes 930% in excess of specifications. The reduction gear and #1 turbine bearing were also vibrating slightly in excess of tolerance, principally in the transverse plane.

c. The vibration levels are not appreciably affected by 24% increase in KW load from a no load condition.

d. All vibration frequencies are at generator shaft RPM.

e. Large vibrations noted on #3 turbine are probably caused by exciter vibration.

4. The vibration is generally produced in all planes, however, in this case the generator foundation restricts the motion to the horizontal plane. Vibration such as this can be developed by: (a) rotor assembly unbalance, (b) bent shafting, (c) Improperly aligned flange coupling, and (d) misaligned exciter bearings. From the data gathered it is impossible to say what combination of these possibilities is producing the vibration.

5. It is therefor recommended that the exciters on both machines be carefully checked for: (a) rotor assembly unbalance, (b) bent shafting, (c) improperly aligned flange coupling (all three planes), and (d) exciter bearing alignment. Final dynamic balancing, in place, by portable balancer is recommended. The final assemblies should not produce more than 1.4 mil (DA) at the bearings when the generator is rotating at 3600 RPM.

6. It is requested that Code 275 be notified when final tests of these machines may be made. Assistance with in-place balancing will also be provided when requested.

See J.O. 164[illegible]-6103-06
Gen Coverage to Balance Exciters
in Place. Includes Balancing of #1
Exciter as well as #2, 3 etc.
H Gray [illegible]

E. C. Middleton, PE

E. C. MIDDLETON
Head, Test Branch

SHIP	MEMO NO.	DATE
USS COLUMBUS (CG12)	CG12-800-275-17	7-31-62
PREPARED BY: D. C. Tufts	SUPERVISOR: J. M. Watson	TEL. NO. 9231

USS COLUMBUS (CG12)
Vibration Survey, report of

Refs: (a) Shaker test of the macks, USS COLUMBUS (CG12), TR-23200
(b) NAVSHIPYD Boston, Speed Ltr (265) CG10 dtd 10 May 1962
(c) MIL STD 167

1. Vibration measurements were made on the USS COLUMBUS (CG12) during the power buildup for the ship's familiarization trial run on 12 June 1962. The ship speeds below 15 knots were made in the channel inside Point Wilson, and those above 15 knots were made in the Straights of Juan De Fuca. The vessel's mean draft was about 24' - 2½", and trim was about 2' - 1" by the stern.

2. Vibration was measured by 22 Statham accelerometers, mounted in locations shown on Sketch No. 1. They were attached to main structural members, at the junction of several members where local panel responses were minimized. Recordings were made by CEC amplifiers, Kintel amplifiers and a Brush recorder, all of which were capable of frequency response down to D.C. Results of these measurements on the macks and the top mast were satisfactory in establishing amplitude and frequency of motion, but were inconclusive in determining mode characteristics. Measurement of hull vibration was completed satisfactorily on the midship and forward portions. Data obtained on the stern area, aft of frame 140, is considered inconclusive since the heavy vibration persisting in this area was recorded only by two pickups, mounted at the stern towing chock.

3. Vibration on the macks was predominately 1st order to shaft rotation frequency, and that on hull aft was exclusively fourth order. Graphic presentation of vibration at points of major interest are shown in figures 1 thru 8.

4. Maximum vibration at the base of the TACAN antenna on the top mast of the fwd mack was .205 inches double amplitude (DA) in the longitudinal direction at a ship speed of 20 knots (190 SRPM). The sharply peaked response curve, see figure 1, indicates a natural frequency for longitudinal motion of the top mast at 190 CPM. This information augments that of Ref (a) in which frequencies were not extended low enough to detect the 190 CPM resonance. The maximum athwartship vibration of the top mast was .140 inches DA at 22 knots (210 SRPM).

5. The maximum amplitude at the top of the fwd mack was .169 inch DA at 24 knots (231 SRPM). See figure 3. This vibration was in the athwartship direction and its frequency was 231 CPM or 3.9 CPS. The latter does not correlate with reference (a) in which no natural frequency was found above 160 SRPM. Also, this 231 CPM frequency is higher than that stated in reference (b). No appreciable vibration in the longitudinal direction was found in the range of speeds investigated. This agrees with finding of references (a) and (b). The maximum amplitudes on the Aft mack were .087 inches DA at 22 knots (210 CPM) in the athwartship direction and .100 inches DA at 28 knots (272 CPM) in the longitudinal direction. (See figures 4 and 5). The 210 CPM frequency for athwartship vibration agrees

Sheet 1

COPY TO: 250, 254, 273
275(3), 270, 248, 244, 213, C.O., USS COLUMBUS (CG12), Commander, NAVSHIPYD Boston

CODE	275	270	248	244						864	275
INITIAL											
DATE	7/31/62	8/1/62	8/3	8/							

with the natural frequency stated in references (a) and (b). The indication of a natural frequency for longitudinal vibration at 272 CPM agrees within 10 CPM with both reference (a) and (b).

6. Figures number 7 and 8 show the vibration recorded in transverse and vertical direction at frame 166, near the towing chock at the stern. This vibration was 4th order to propeller shaft RPM. The maximum level in transverse direction was 18 mils DA at about 1000 CPM, and in vertical direction 38 mils and 30 mils at frequencies of 760 CPM and 1000 CPM respectively. The 4th order vibration recorded by other pickups on the hull, forward of frame 140 did not exceed 3 mils DA and was considered insignificant. Also, sensory observations made throughout the stern area at the higher speeds indicated that vibration severity progressively increased aft of frame 140 to the stern. Although vibration and associated noise was noticeable throughout the stern area on 2nd deck, 3rd deck, and in the helicopter hanger, no serious resonances of structure or equipment were evident.

7. The amplitudes of vibration for both hull and macks on the USS COLUMBUS (CG12) are higher than found on the USS ALBANY (CG10). This difference may be partially due to differences in points of measurement. For example, hull vibration at the stern of the USS COLUMBUS (CG12) was measured at frame 166 where vibration is expected to be greater than at frame 154, the point of measurement on the USS ALBANY (CG10).

8. Vibration levels on the topmast and the macks are not considered excessive unless their motion induces a more severe, resonant response of antennas or equipment mounted thereon. Since reference (c) quotes a maximum amplitude of ship hull vibration as 60 mils (DA) in frequency range of 5 to 10 CPS, the amplitudes up to 200 mils measured on the topmast, far above the basic hull and at frequency of only 3 CPS appear tolerable. These latter motions result in mild structural loadings of about .09 G. Vibration in vertical direction at the stern for speeds around 28 knots exceed the limits of reference (c). Since this vibration was confined to the stern portion of the vessel, and since no existance of severe local resonances were observed, it is not considered a serious deficiency.

9. It is reccommended that:

a. No further vibration investigation of the macks and topmast be undertaken unless a major change in loading is made.

b. A limited survey with portable equipment be made during the next trial to determine and investigate all local resonance problems.

c. An instrument survey be made of the hull aft of fram 140.

Edwin C. Middleton

E. C. MIDDLETON
Head, Test Branch

C.H.
5/3

KEUFFEL & ESSER CO., N. Y. NO. 359-11
10 × 10 to the ½ inch, 5th lines accented
Engraving, 7 × 10 in.
MADE IN U. S. A.

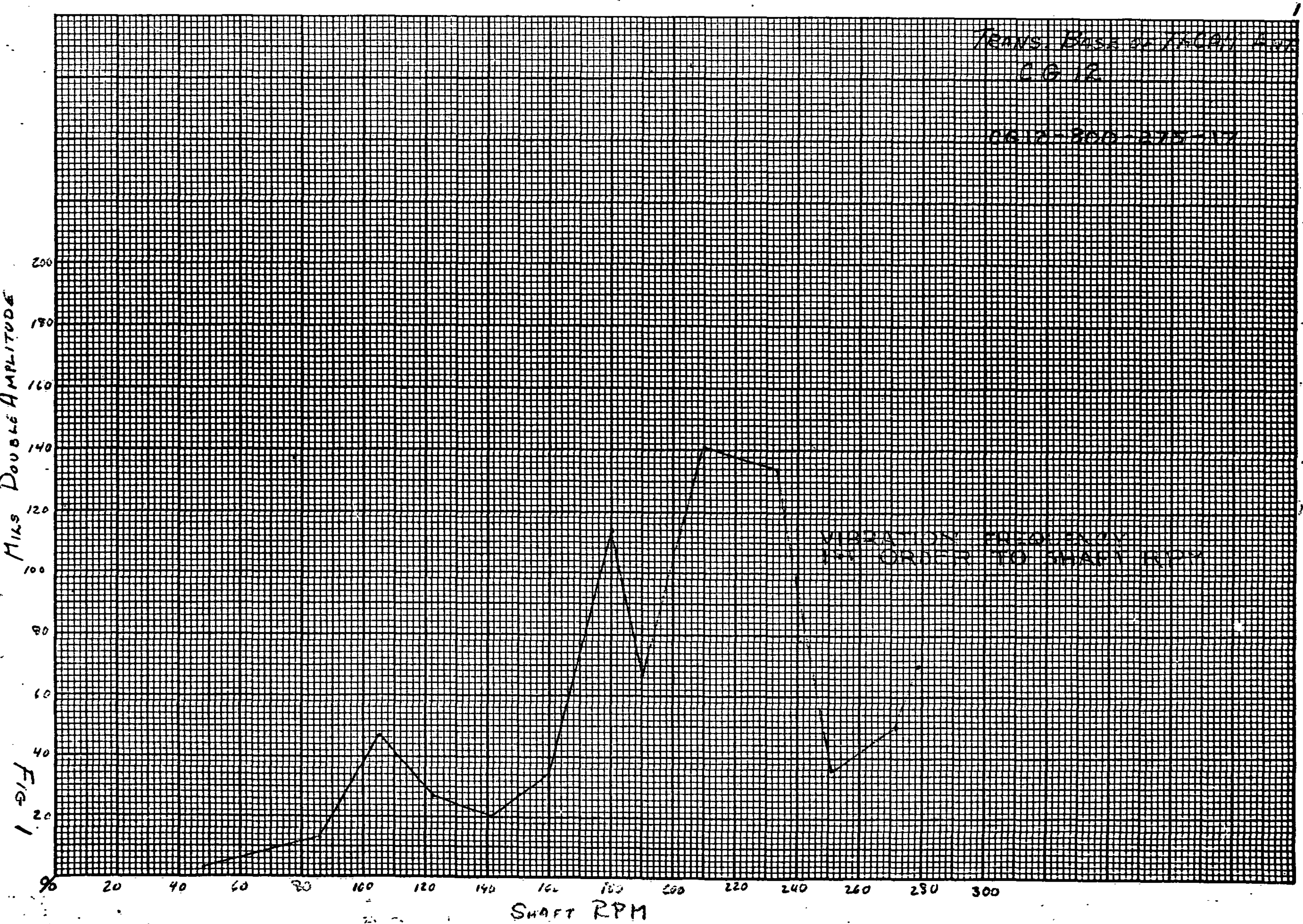


FIG 1

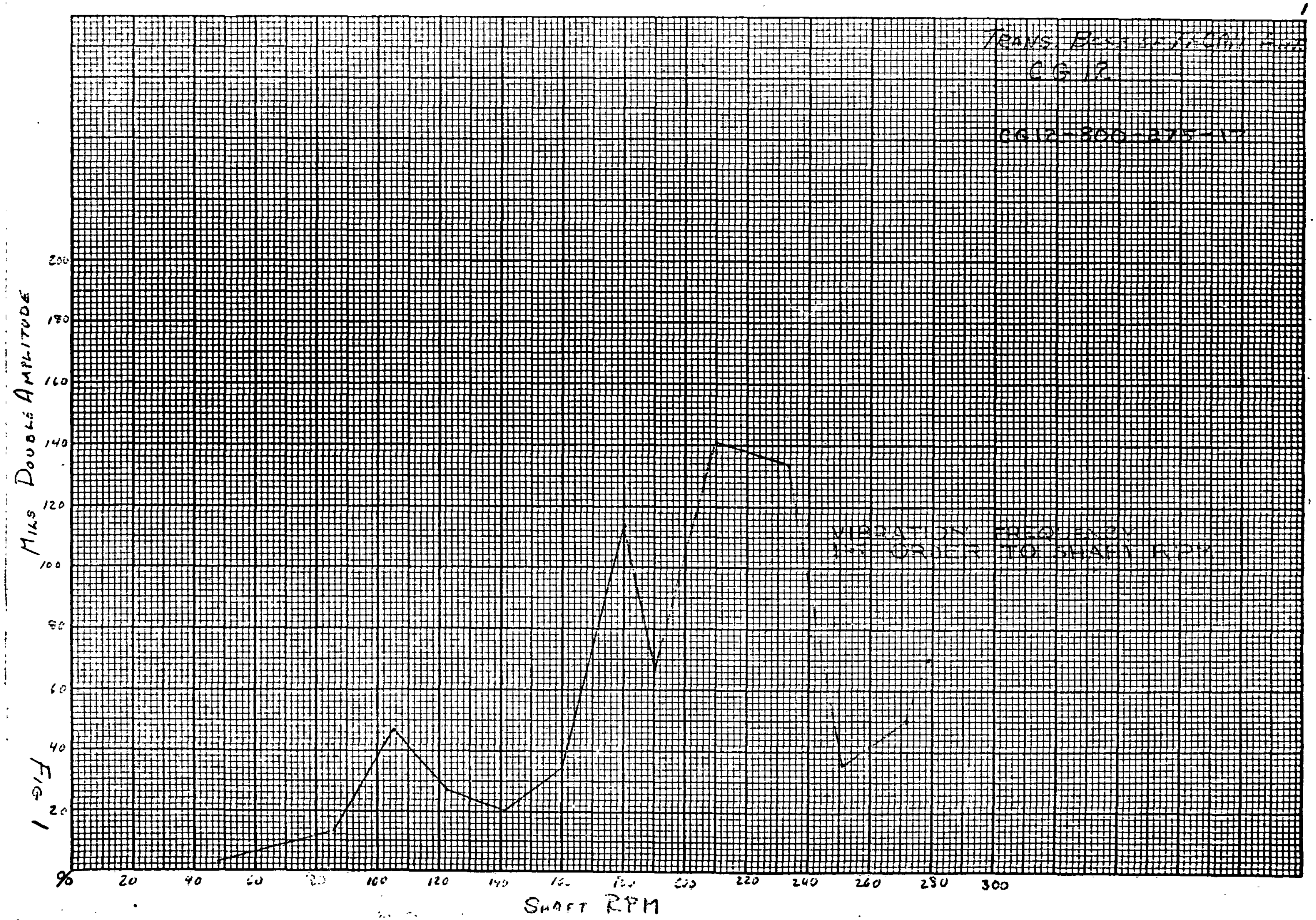

CG12
CG12-800-275-17
VIBRATION FREQUENCY
1st ORDER TO SHAFT RPM
Mils Double Amplitude
200
180
160
140
120
100
80
60
40
20
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Shaft RPM

FIG 1

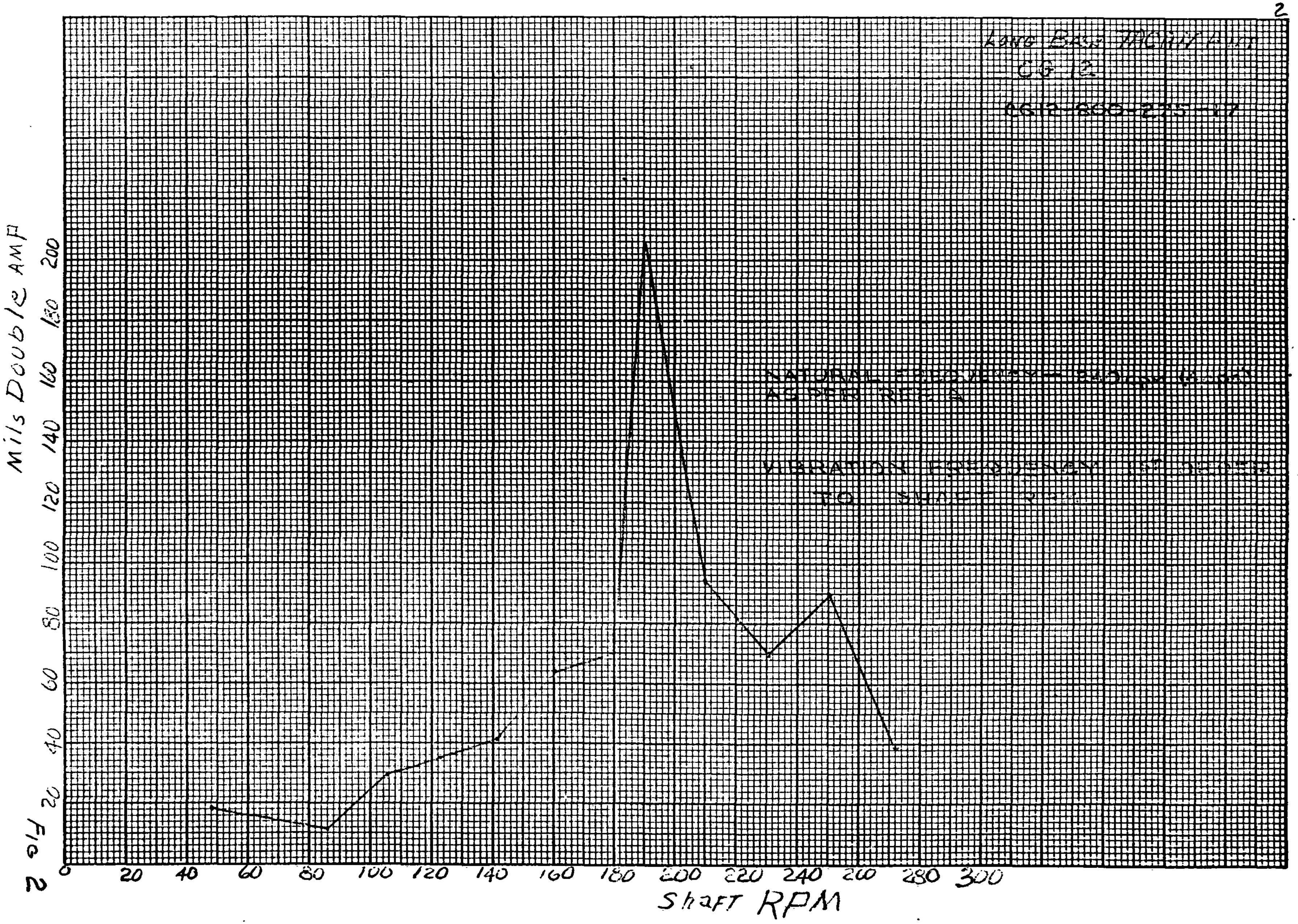

2
CG 12
0612-800-225-17
NATURAL
AS PER
VIBRATION
TO
Mils Double AMP
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Shaft RPM

FIG 2

KEUFFEL & ESSER CO., N. Y. NO. 359-11
10 × 10 to the ½ inch, 5th lines accented
Engraving, 7 × 10 in.
MADE IN U. S. A.

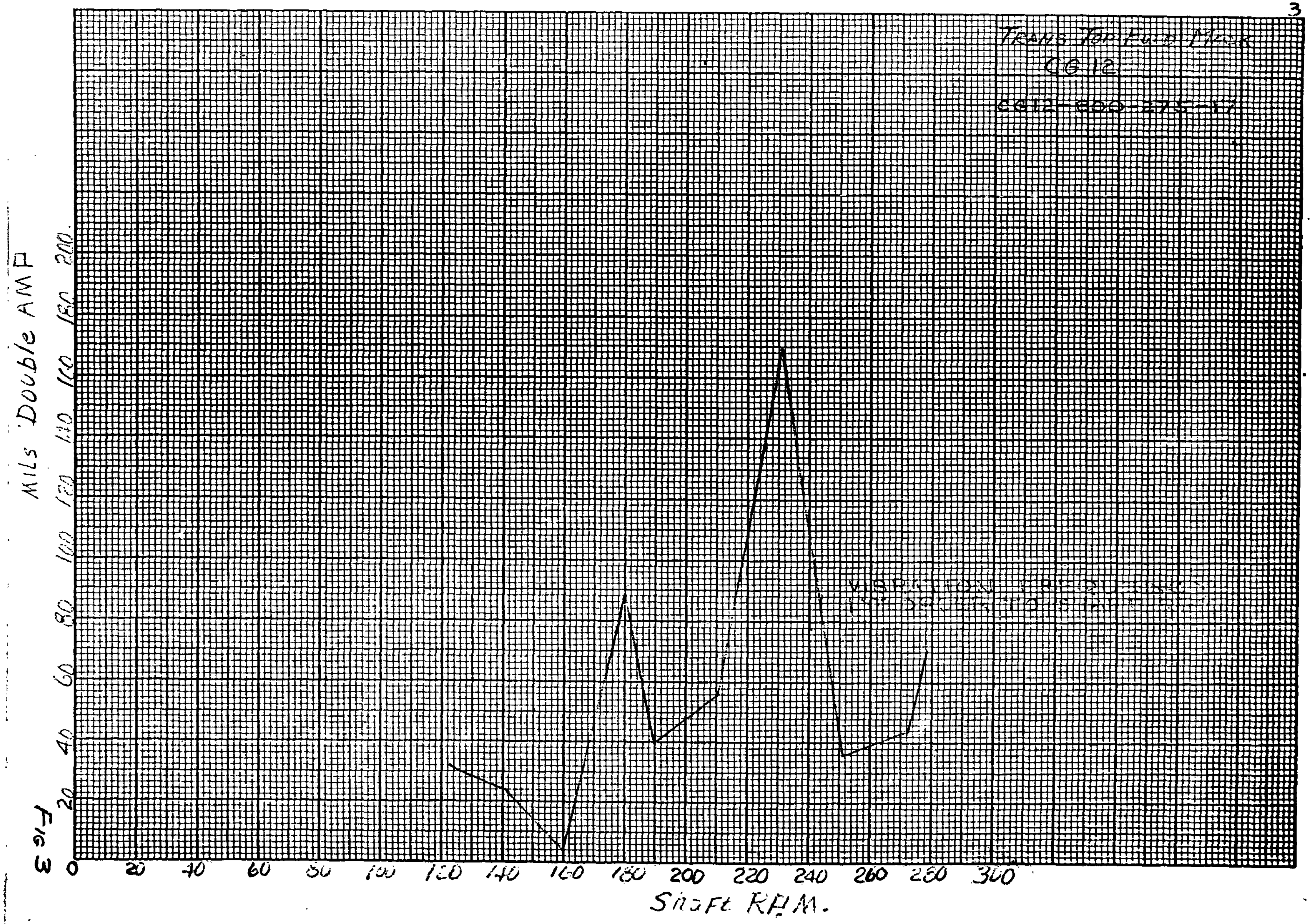


FIG 3

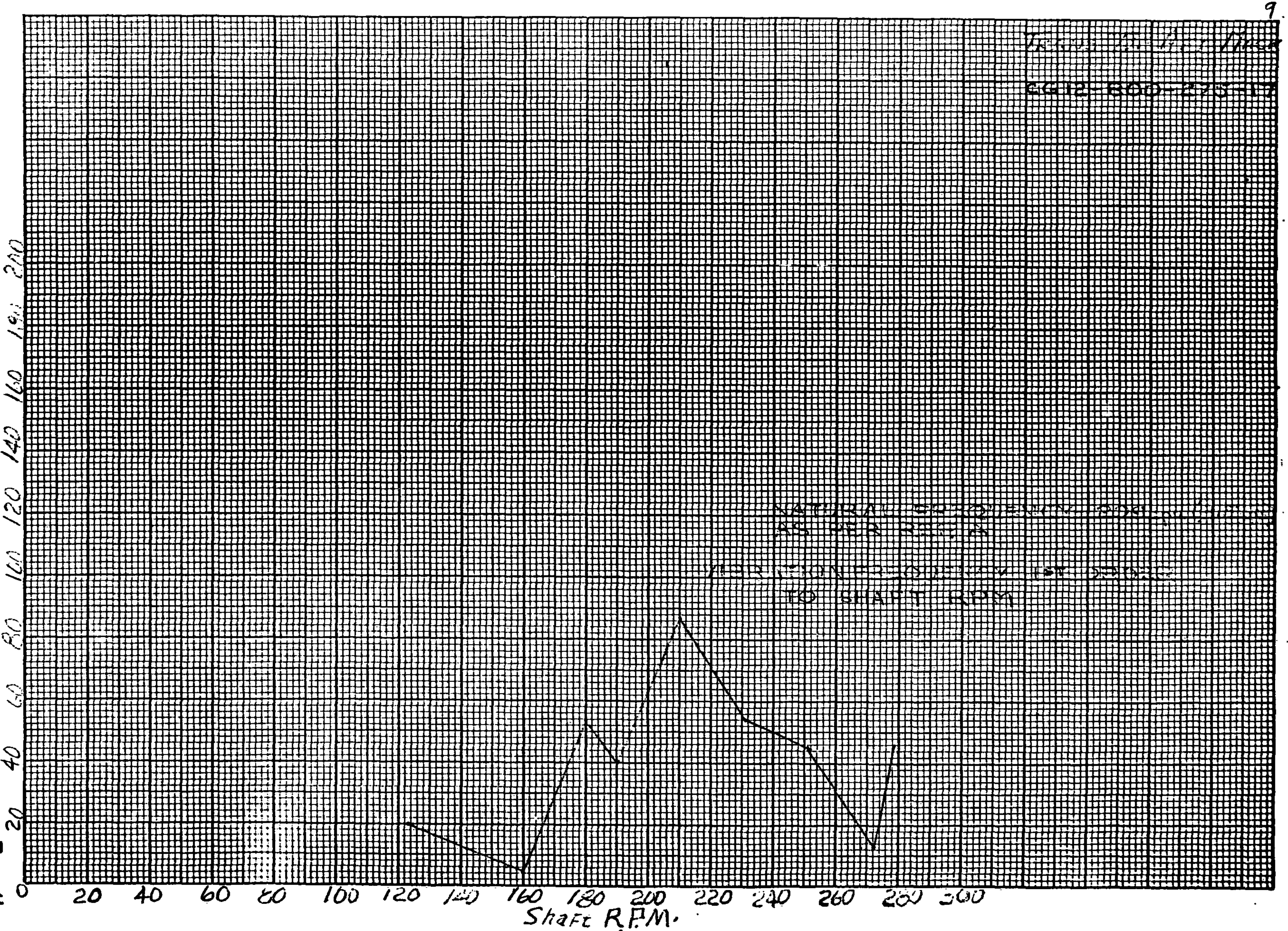

EG12-800-275-17
TO SHAFT RPM
Mils Double AMP
0
20
40
60
80
100
120
140
160
180
200
220
240
260
Shaft R.P.M.

Fig 4

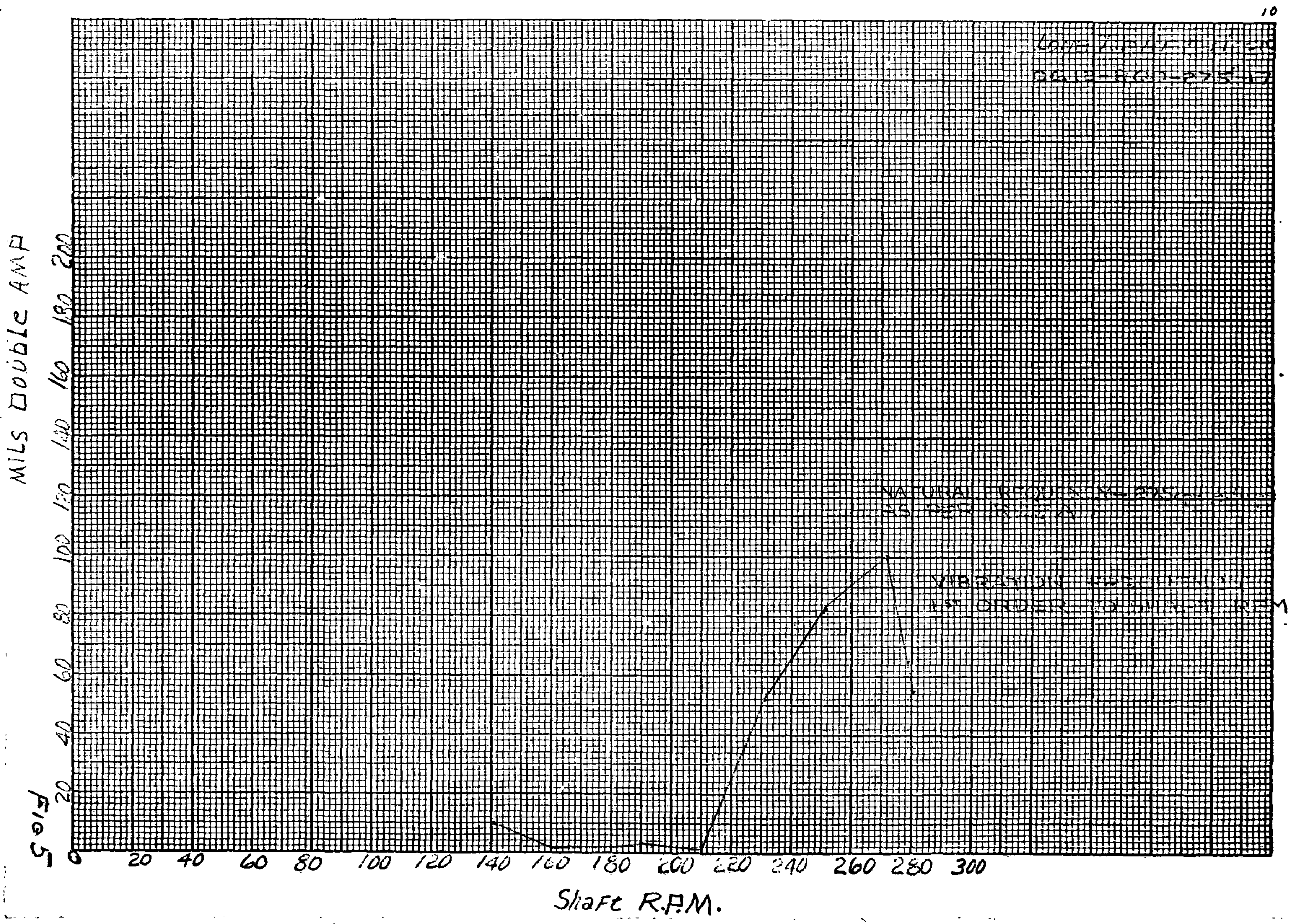

Mils Double AMP
Shaft R.P.M.
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
VIBRATION
1ST ORDER
RPM

Fig 5

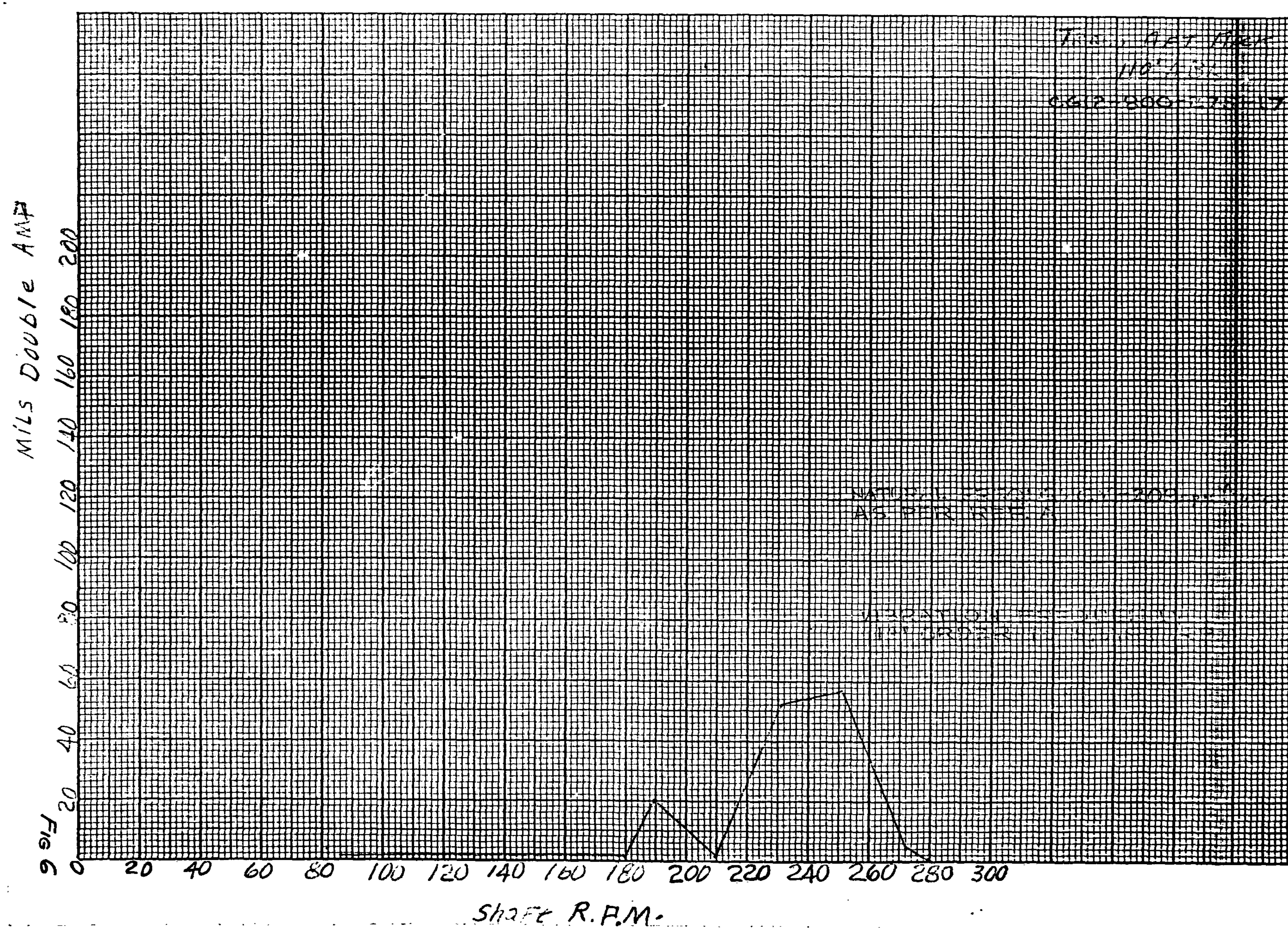

Mils Double Amp
0
20
40
60
80
100
120
140
160
180
200
Shaft R.P.M.
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300

Fig 6

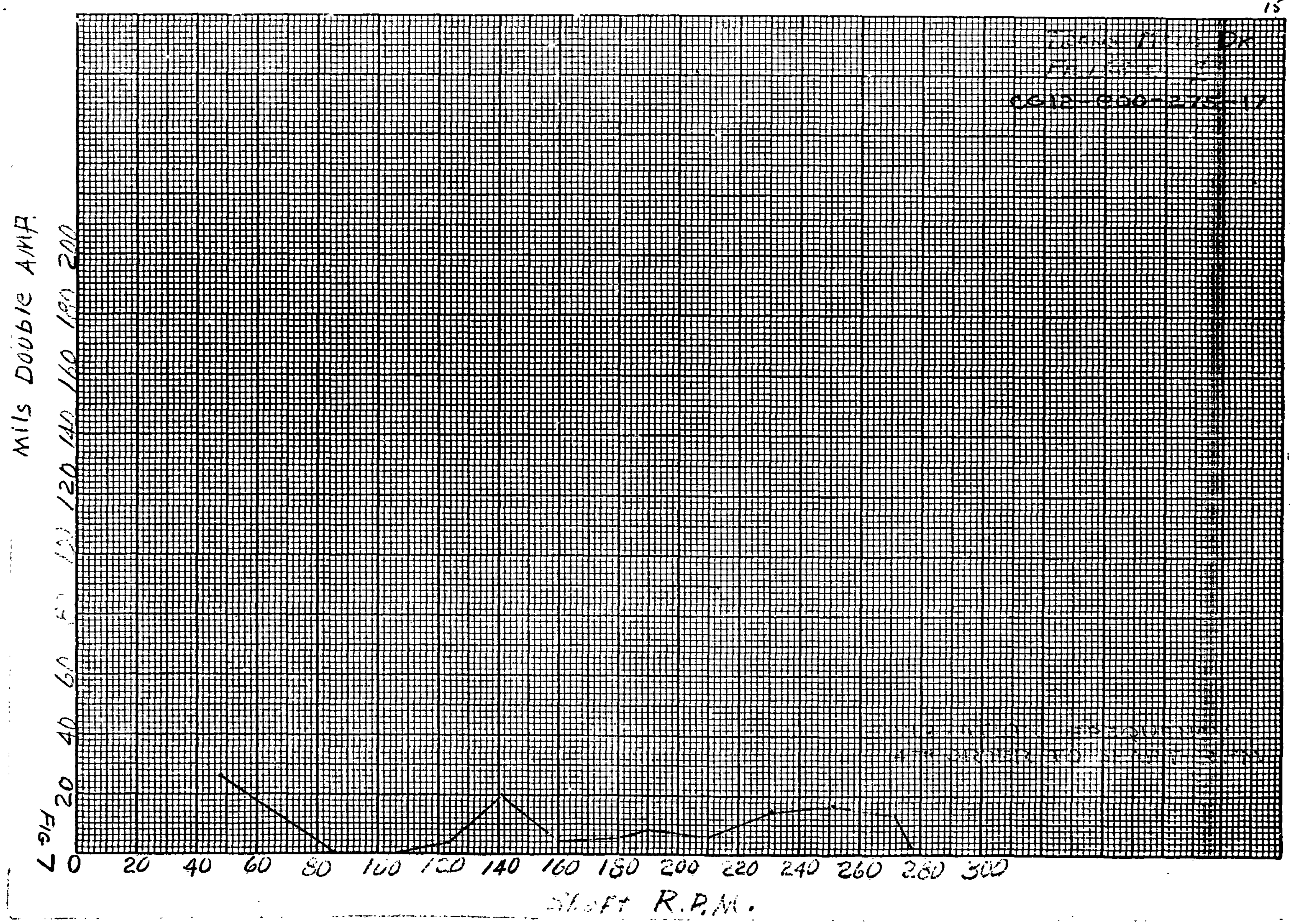

CG12-800-275-17
Mils Double AMP
20 40 60 120 140 160 180 200
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Shaft R.P.M.

FIG 7

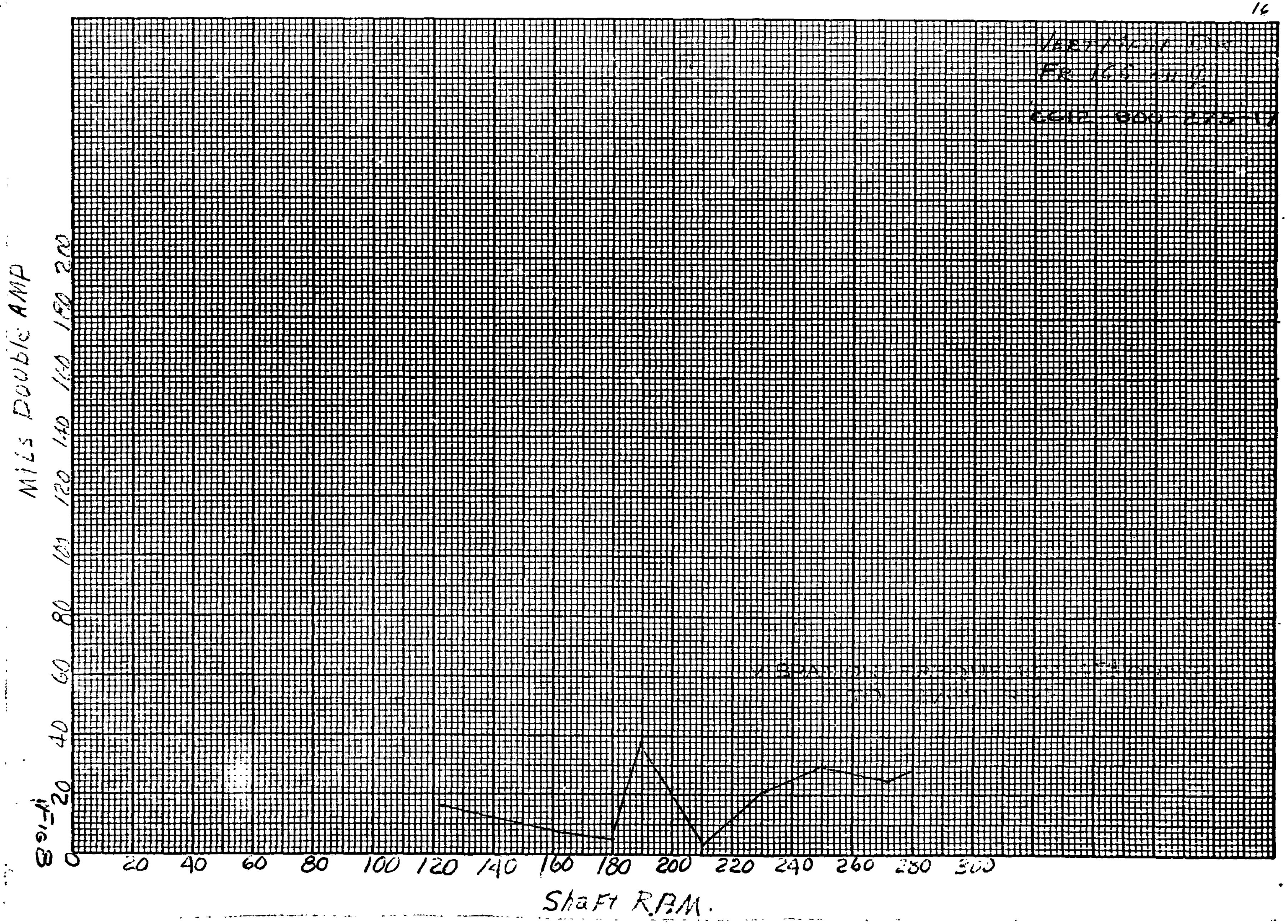
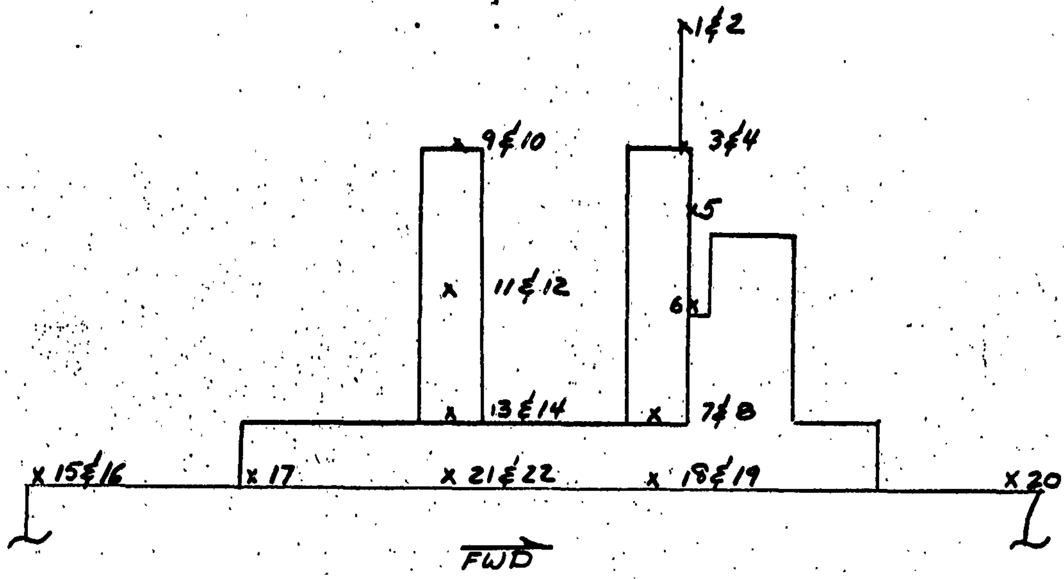

Mils Double AMP
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Shaft R.P.M.

Fig 8



STATION NO.	PICKUP DIRECTION	PICKUP LOCATION
1	Trans	Base of TACAN Ant
2	Long	Base of TACAN Ant
3	Trans	Top Fwd Mack
4	Long	Top Fwd Mack
5	Trans	Fwd Mack 127' ABL
6	Trans	Fwd Mack 115' ABL
7	Trans	Base of Fwd Mack 02 Dk
8	Long	Base of Fwd Mack 02 Dk
9	Trans	Top Aft Mack
10	Long	Top Aft Mack
11	Trans	Aft Mack 110' ABL
12	Long	Aft Mack 110' ABL
13	Trans	Base of Aft Mack 02 Dk
14	Long	Base of Aft Mack 02 Dk
15	Trans	Fr 166 on ℄
16	Vert	Fr 166 on ℄
17	Trans	Fr 140 on Port Side
18	Vert	Fr 96 on Port side
19	Vert	Fr 96 on Stbd side
20	Vert	Fr 76 on Port Side
21	Vert	Fr 76 on Stbd side
22	Trans	Fr 1 on ℄

Sketch 1

NAVSHIPBREM-9031/24 (Rev. 6-61)

JOB ORDER No.

SHIP NO.	SHIP	MEMO NO.	DATE
	USS PARKS (DD884)	DD884-800-275-73	8-3-62
OTHER CASE NO.	PREPARED BY	SUPERVISOR	TEL. NO.
	D. C. Tufts	J. M. Watson	9231

DESIGN DIV. JOB ORDER

USS FLOYD B. PARKS (DD884)
Pre-overhaul hull vibration survey, report of

Ref: (a) NAVSHIPBREM Test Memo DD884-800-T-23314
(b) Mil Std 167

1. A pre-overhaul vibration was conducted on the USS PARKS (DD884) on 5 April 1962 as requested by the Type Desk (Code 213). Work on this report was suspended when the FRAM overhaul was tentatively cancelled and is now submitted for application to the current conversion.

2. The vibration trial was conducted in conformance with reference (a). Amplitudes of vibration recorded during this trial were all well below those stated in ref (b) for all speeds up to 330 SRPM. Hull vibration under the mast did not exceed 2 mils, and vibration on the mast did not exceed 5 mils. All significant vibration observed was at a frequency 4th order to propeller RPM. It is concluded that the bow replacement on this vessel has not created a serious vibration deficiency.

3. No recommendations are made for action to reduce the hull vibration observed on this ship. However, it is recommended that normal repair and conversion procedures be followed in repair and balancing of propeller and shafting. It is not known what the vibration characteristics of the ship will be after completion of the FRAM overhaul, but observations from the USS BRINKLEY BASS indicate that addition of the FRAM mast and aluminum deck house structure may induce vibration problems. The latter may be minimized by providing an accurate balance and alignment of the propulsion system.

J Malcolm Watson
Ea E. C. MIDDLETON
Head, Test Branch

COPY TO: 275(3), 270, 244, C.O. USS PARKS, 248, 213

CODE	275	270	248	244	[redacted]			864	275
INITIAL	Jmw	RWT							
DATE	8/3/62	8/3/2	8/6	8/6					

nb

Ship	Memo No.	Date
USS WRIGHT (CC2)	CC2-404-275-2	10-11-62

Prepared by	Supervisor	Tel. No.
E. C. Greene W.J. Beckman	J.M. Watson	9231

Pressure and Vibration Tests of RG-270/U Coax Cable

Ref: (a) Planning Dept Memo CC2-404-273-02 of 20 June 1962
(b) Test Memo CC2-404-T-23462, Pressure Test of RG-270/U Coax
(c) Andrew Drawing No. D-H7

1. Pressure and vibration tests of a sample RG-270/U cable were requested by reference (a). These tests were conducted in accordance with reference (b). Work was done on the M-B vibrator in the interval of 20 September 1962 to 25 September 1962. End fittings, types 77R and 21L, were used for the tests.

2. Description of Tests:

The cable and fittings were installed on an "MB" 50 pound electrodynamic vibrator as shown in sketch A. This configuration was an attempt to approximate one of the many vibrational modes the transmission system might be subjected to aboard ship. Preliminary investigation revealed that pressures less than 40 psig were insignificant tests for the system. Therefore, vibrational tests were conducted at 40 psig, the maximum pressure indicated by reference (a). Frequency scanning discovered significant cable resonant modes at 4.7, 9.4, and 10.3 cps, ~~frequencies ... present aboard ship~~. The cable system was subjected to approximately 1g acceleration at the vibration table for two hours at each of the resonant frequencies. The cable configuration was then changed to that shown in Sketch B. By clamping the end fittings rigidly and driving the cable at the center, it was intended to induce maximum stresses at the end fitting - cable junction. Again, for two hours each, the system was excited by 1G of table motion at 4.7, 9.4, and 10.3 cps. Using the previous test setup, the end fittings were heated to 145°F., and vibrated by 2G table acceleration at 10.3 cps for 4 hours. This operation was intended to test the durability of organic packings at elevated temperatures. Finally, the coax and end fittings were subjected to extreme hydro static pressures. This was done in order to locate the weak link in the coaxial system, and to find the safety factor for the system operating at 40 psig.

3. Findings:

The coax and fittings endured 1,757,000 cycles at one "G" acceleration and 1,433,000 cycles at 2 "G" acceleration with no sign of deterioration or malfunction. During these tests internal pressure in a 150 cubic inch volume dropped from 40 psig to 38.5 psig. This represents a 0.75% drop per day. An unknown part of this leakage can be attributed to external piping and instrumentation. Reference (c) indicates an allowable pressure drop of 8.3% per day at 12 psig for similar volumes. Heat did not affect the packings in the four hours tested. Hydrostatic pressure attained 280 psig before an "O" ring in the type 21L fitting ruptured. No other damage was noted. This would give the system, when operating at 40 psig, an approximate pressure safety factor of 7.

Copy to: 275(3), 270, 244, 275(1)

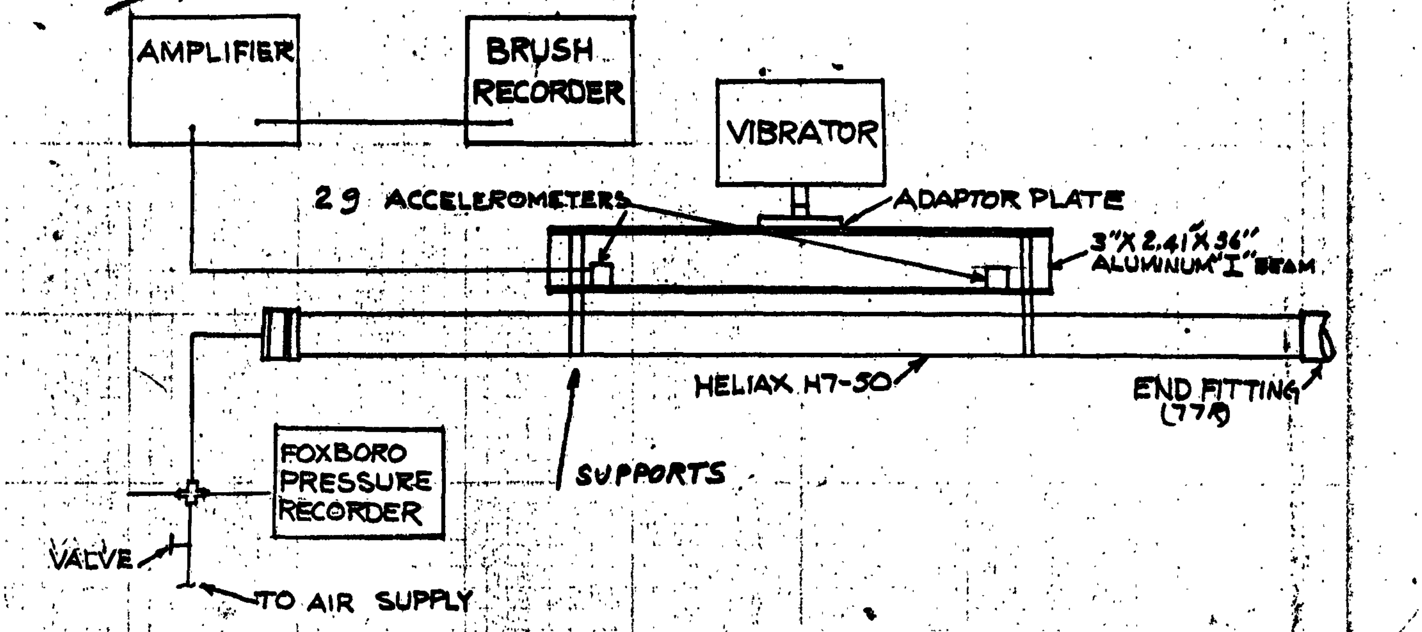
Code	275	270	~~255~~	273	248	244		864	275
Initial		PWS		ROT		WHR			
Date	10/15	10-15-62		10/16	10/17	10/19			

4. Conclusions:

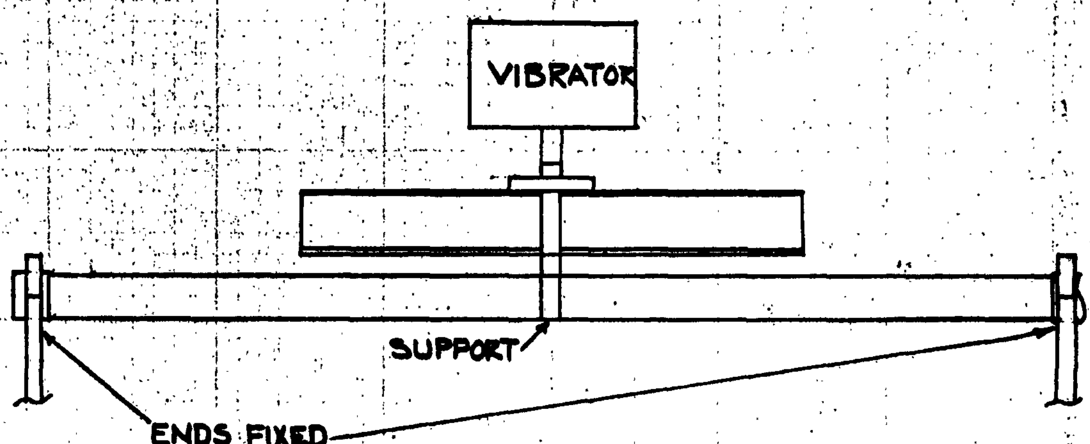
The RG-270/U coax and fittings can be satisfactorily used aboard ship when pressurized to 40 psig. It is expected to withstand extreme vibration and elevated temperatures up to 145°F. without excessive loss of pressure. The system, when operated in static conditions at 40 psig, has a pressure safety factor of about 7.

Edwin C. Middleton, PE

E. C. MIDDLETON
Head, Test Branch



SKETCH A



INSTRUMENTATION SAME AS ABOVE

SKETCH B

USS BUCHANAN (DDG14) DDG14-300-275-4 2 Nov 1962

W. J. Beckman J. M. Watson 9231

14427-8001-01

Vibration Survey of Ship's Service Turbo-Generators No's. 1A and 1B

Ref: (a) INSURV items E501 and E502
(b) MIL-STD-167

1. Initial vibration measurements of Ship's Service Turbo-Generators No's 1A and LB began at pierside on 9-21-62 in response to reference (a). Subsequent measurements and balancing was terminated on 10-19-62.

2. Original measurements found each generating system producing at 30 CPS) excessive vibration. Additional investigation indicated that both generator-exciter systems were not in dynamic balance. It was noted that the supporting structure of the two generating plants tended to accentuate the resulting vibration. Code 275 recommended in-place balancing as a solution.

3. Balancing was begun on Turbo-Generator No. 1B in the exciter end-plane. A moment of 6 in.-oz. was required to bring this plane into dynamic balance at 1800 RPM. However, though the vibration was reduced in the exciter, no improvement was noted at the turbine end. It was decided that an additional balance plane was required. The exciter end of the generator rotor was chosen as the second plane. A moment change of 26 in.-oz. was required to bring the second plane into limits. The inter-action of the two planes then required the removal of the 6 in.-oz. moment from the exciter plane. The iterative process of balancing from plane to plane, was, at this point, interrupted by calibration failure of the IRD Vibration Analyzer. Because of time limitations, balancing on Turbo-Generator No. 1B was not finished. No balancing was accomplished on Turbo-Generator No. 1A due to time limitations. Table I notes the vibration measured on the machines in their present balance condition. (For Table I, See Page 2.)

4. It is recommended that Turbo-Generators No's. 1A and LB be dynamically balanced to within limits of reference (b). Specifications at the earliest date possible.

E. C. MIDDLETON
Head, Test Branch

275(3), 270, 244

275 270 244 864 275

TABLE I

Both machines under load simultaneously.

Machine	Load, %	Mode	Turbine End Bearing	Location Bull Gear	Exciter End Bearing
		V	2.5	0.5	3
	Ø	T	5	1	1
		L	1	2	1.5
		V	2	3.5	2.5
1A	50	T	4	4	1
		L	2	2	1
		V	4	4	3
	100	T	5	4	1.5
		L	1	1	0.5
		V	1.5	2	2.5
	Ø	T	1.5	2	1
		L	1.5	1.5	1
		V	1.5	2	4
1B	50	T	2	1.5	3
		L	1	1.5	1.5
		V	3	3	5.5
	100	T	4	2	4
		L	2.5	2	4

ALL MEASUREMENTS IN

MILS DA

JOB ORDER No. 1790-6202-06

SHIP	MEMO NO.	DATE
USS EVERSOLE (DD789)	DD789-800-275-88	11-7-62

PREPARED BY	SUPERVISOR	TEL. NO.
J.E. McCarn	J.M. Watson	9231

DESIGN DIV. JOB ORDER

Vibration of 400 Cycle Motor
Generator Sets, Main Deck, Fr 110
Stbd; Report of

Ref: (a) Mil-Std-167

1. In performance of shop acceptance tests of the 400 cycle M.G. sets an excessive vibration was observed. Measurements were made which disclosed a maximum vibration of 6 mils, double amplitude, at rotor frequency. Reference (a) allows 1.6 mils, double amplitude. The vibration transmitted into the deck was 2 mils double amplitude.

2. It is recommended that the two M.G. sets be dynamically balanced to meet the requirements of reference (a). A fine degree of balance will be required. Accomplish balancing in place aboard ship, if feasible.

3. Notify Code 275 after balancing is complete and generators are ready for retest.

E. C. Middleton, PE
E. C. MIDDLETON
Head, Test Branch

ACCOMPLISH ON ABOVE J.O.

275(3), 270, 244, 3768, 51, 38
(5) (5)

CODE	275	270	244	213	233	3768	864	275
INITIAL		PWS	WHE		EO			
DATE	11/8	11-8-62	11/8	12/4	12/4	12/4		

1790-6202-06